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Organizations having a NASA contract may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017.

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-25550# Northrop Corp., Hawthorne, Calif. Norair Div.
SUMMARY OF LAMINAR BOUNDARY LAYER CONTROL RESEARCH, VOLUME I Technical Documentary Report, Jul. 1959–Mar. 1963
Wright-Patterson AFB, Ohio, ASD, Mar. 1964 449 p refs
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N65-25553 Northrop Corp., Hawthorne, Calif. Norair Div.
CROSSFLOW STABILITY CALCULATIONS ON HIGHLY SWEPT (65° SWEEP) SUPERSONIC LOW DRAG BLC WING (MACH NUMBER 1.8) WITH AND WITHOUT COOLING
W. Byron Brown *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 68–72 refs (See N65-25550 15-01)

A simplified version of the complete Lees-Lin equations has been used to compute the stability of the crossflow profiles on a highly swept (65-degree sweep) supersonic low drag BLC wing at Mach number of 1.86 with and without cooling. Two crossflow profiles (velocity and temperature) were considered. Four stability curves were computed, two for each profile. Because the boundary condition at the wall is different for high and low disturbance frequencies, each condition was computed for each profile. For comparative purposes the Orr-Sommerfeld equation was applied to the two velocity profiles, the temperature profiles being neglected. N.E.A.

N65-25555 Northrop Corp., Hawthorne, Calif. Norair Div.
EXPERIMENTAL INVESTIGATION AND THEORETICAL ANALYSIS OF LAMINAR BOUNDARY LAYER SUCTION ON A 30° SWEPT, 12-PERCENT-THICK WING IN THE NASA AMES 12-FOOT PRESSURE WIND TUNNEL
L. W. Gross, J. W. Bacon, Jr., and V. L. Tucker *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 96–110 refs (See N65-25550 15-01)

Low drag boundary layer suction experiments were conducted at high Reynolds numbers in the Ames 12-foot pressure tunnel on the Norair 30° swept, 12-percent-thick, symmetrical laminar suction wing at $\alpha = 0, \pm 1, \pm 1.5$ and $-2°$ angles of attack. At five atmospheres tunnel pressure full chord laminar flow was maintained up to a wing chord Reynolds number $R_c = 29 \times 10^6$ within an angle of attack range of $\alpha = \pm 1°$ with a minimum equivalent total drag coefficient at $R_c = 27 \times 10^6$ of $C_{D_{t_{min}}} = .00097$ for both wing surfaces (including equivalent suction drag) and a corresponding optimum suction quantity coefficient $C_{Q_{opt}} = .00070$. At $\alpha = \pm 1.5°$ full chord laminar flow was maintained up to $R_c = 22 \times 10^6$ and 24×10^6, respectively. Calculation of the boundary layer development for several test points at angles of attack $\alpha = 1°, 0°, +1°$ indicate that the laminar boundary layer on a swept laminar suction wing is affected by both the stability of the tangential flow and the crossflow in the boundary layer. Author

N65-25556 Northrop Corp., Hawthorne, Calif. Norair Div.
EXPERIMENTAL INVESTIGATION OF A 4-PERCENT-THICK STRAIGHT LAMINAR SUCTION WING OF 17-FOOT CHORD IN THE NORAIR 7- BY 10-FOOT WIND TUNNEL
L. W. Gross *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 111–119 refs (See N65-25550 15-01)

Full chord laminar flow and very low wing equivalent total drags were maintained on a 4-percent-thick unswept suction wing of 17-foot chord up to a wing chord Reynolds number of 26×10^6 by means of suction through 100 fine slots. Without tunnel wall fairings, the minimum wing equivalent total drag coefficient for one wing surface (including the equivalent suction drag) was $C_{D_{t_{min}}} = .000375$ at $R_c \cong 25 \times 10^6$ and $\alpha = 0$ degree angle of attack; the corresponding suction quantity coefficient (based on wing projected area) was $C_{Q_{opt}} = .000130$. The maximum wing chord Reynolds number with full chord laminar flow was twice as large as that measured in the same tunnel on a 30-degree swept laminar suction wing of 7-foot chord and was probably limited by wind tunnel noise as well as by the number of suction slots used. The maximum attainable wing chord Reynolds number with full chord laminar flow was only slightly influenced by moderate changes of the external pressure distribution. These changes were obtained by varying the angle of attack and by putting fairings on the tunnel walls opposite the model. An increased overall flow acceleration along the wing chord resulted in somewhat higher wing chord Reynolds numbers with full chord laminar flow and, conversely, the maximum wing chord Reynolds number with 100 percent laminar flow was somewhat reduced when the flow was more strongly decelerated along the chord, as compared with the model at $\alpha = 0$ degree angle of attack without tunnel wall fairings present. Author

N65-25557 Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATIONS OF A 30° SWEPT AND A 17-FOOT CHORD STRAIGHT SUCTION WING IN THE PRESENCE OF INTERNAL SOUND, EXTERNAL SOUND, AND MECHANICAL VIBRATIONS
J. W. Bacon, Jr., W. Pfenninger, and C. R. Moore *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 120–154 refs (See N65-25550 15-01)

A 4-percent-thick straight laminar suction wing of 17-foot chord and a 30° swept, 12-percent-thick laminar suction wing of seven-foot chord were investigated in the Norair 7- by 10-foot low turbulence wind tunnel at $\alpha = 0°$ angle of attack in the presence of external sound (longitudinal and transverse sound waves). The 4-percent-thick straight wing was tested, in addition, with internal sound and panel vibration. The external and internal sound consisted of discrete frequencies and octave bands of random noise in the 150 to 4000 cps. The straight wing showed a frequency dependence of transition with external sound that correlates with the stability theory for amplified Tollmien-Schlichting oscillations. On the swept laminar suction wing under the influence of external sound, however, transition occurred over a wide range of frequencies. For the swept wing in smooth condition the critical sound particle velocity ratio at transition generally decreased at a somewhat slower rate than inversely proportional to the wing chord Reynolds number. Author

N65-25558 Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATION OF A LAMINAR SUCTION MODIFIED SEARS–HAACK BODY OF REVOLUTION IN THE NORAIR 7- BY 10-FOOT WIND TUNNEL
L. W. Gross *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 155–165 refs (See N65-25550 15-01)

Full length laminar flow with very low friction and equivalent total drags was maintained on a 9-to-1 fineness ratio laminar suction modified Sears–Haack body of revolution of 142-inch length up to a length Reynolds number $R_L = 20.1 \times 10^6$ by means of suction through 120 fine slots. The coefficient of equivalent total drag (based on wetted area and including the equivalent suction drag) at an angle of attack $\alpha = 0°$ was 1.18 times the laminar flat plate friction coefficient up to $R_L = 19.6 \times 10^6$ with a corresponding suction quantity coefficient (based on wetted area) $C_{Q_t} = 1.75 \times 10^{-4}$. At an angle of attack $\alpha = 2°$ the minimum equivalent total drag coefficient varied from 1.18 times the laminar flat plate friction coefficient C_f at a Reynolds number $R_L = 6.3 \times 10^6$ up to 1.45 C_f at $R_L = 16.19 \times 10^6$. An equivalent total drag coefficient $C_{D_t} = 4.8 \times 10^{-4}$ was measured at $R_L = 16.19 \times 10^6$ requiring a total suction quantity coefficient $C_{Q_t} = 1.95 \times 10^{-4}$. Full length laminar flow at $\alpha = 2°$ was observed up to a length Reynolds number $R_L = 18.55 \times 10^6$. Author

N65-25559 Northrop Corp., Hawthorne, Calif. Norair Div.
ANALYSIS OF THE BOUNDARY LAYER DEVELOPMENT ON A MODIFIED SEARS-HAACK SUCTION BODY OF REVOLUTION
Hartmut H. K. Bossel *In its* Sum. of Laminar Boundary Layer Control Res., Vo.. I Mar. 1964 p 166–171 refs (See N65-25550 15-01)

The laminar boundary layer development in incompressible flow over a modified Sears-Haack low drag suction body of revolution of 142-inch length was computed by means of Raetz's method (Reference 45). The theoretical data obtained are compared with experimental data for eight test points at length Reynolds number from 6.3 to 19.6×10^6. The theoretical data are in satisfactory agreement with the experimental data although they are not exactly comparable, since pure axisymmetric flow was not achieved during the experiments. Author

N65-25560# Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section
SUMMARY OF LAMINAR BOUNDARY LAYER CONTROL RESEARCH, VOLUME II
Wright-Patterson AFB, Ohio, ASD, Mar. 1964 446 p refs (Contract AF 33(616)-7564)
(ASD-TDR-63-554, Vol. II; AD-605186)

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N65-25564 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

INVESTIGATIONS OF SWEPT WINGS WITH SUPERSONIC LEADING EDGES LOW DRAG BOUNDARY LAYER SUCTION EXPERIMENTS ON A 36° SWEPT WING AT MACH NUMBERS 2.5, 3.0, AND 3.5

E. E. Groth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 464–480 refs (See N65-25560 15-01)

A 36° swept suction wing of 3-percent-thick biconvex section was tested at AEDC Tunnel A at Mach numbers between 2.5 and 3.5. Laminar flow and low drag coefficients were maintained up to the highest tunnel pressures, resulting in length Reynolds numbers of 17, 25 and 20 × 10^6 at Mach numbers 2.5, 3.0 and 3.5, respectively. The computation of the laminar boundary layer development along the wing chord for typical test conditions provided numerical values of crossflow Reynolds numbers with full laminar flow. Two separate tests were conducted. The first model with the original–relatively narrow–slots was successful at M = 2.5 and in the Reynolds number range up to R = 13 × 10^6 at M = 3.0. The second model, with wider slots, provided satisfactory data at M = 3.0 and 3.5 at further increased chord Reynolds numbers. Both models were rather sensitive to the local suction quantities. Author

N65-25565 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

BOUNDARY LAYER TRANSITION MEASUREMENTS ON SWEPT WINGS AT SUPERSONIC SPEEDS

E. E. Groth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 481–486 refs (See N65-25560 15-01)

Boundary layer transition measurements were conducted in AEDC Tunnel E-1 on two-dimensional swept wings of 24, 36 and 50° sweep at Mach numbers between 2.5 and 5.0. Two models were built; one had a 3-percent-thick biconvex section, and the other section was a combination of a straight wedge with a biconvex section. The test results showed a strong dependence on the leading edge bluntness. The measured reduction of transition length Reynolds number due to sweep was of the same order as obtained on blunt flat plate models from earlier NASA measurements. The effect of the two different airfoil sections on transition was negligible. Author

N65-25566 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

INVESTIGATION OF LAMINAR FLOW CONTROL AIRFOILS SWEPT BEHIND THE MACH ANGLE. LOW DRAG BOUNDARY LAYER SUCTION EXPERIMENTS ON A 72° SWEPT WING MODEL AT MACH NUMBER 2.0 AND 2.25

J. Goldsmith *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 487–508 refs (See N65-25560 15-01)

An investigation was made to determine the effectiveness of combining the advantages of laminar suction with sweepback in excess of the Mach angle for the purpose of obtaining low drags on supersonic airfoils. This initial investigation was limited to that portion of a wing over which the flow could be considered two-dimensional in nature, i.e., the region where the flow field was similar to that of an infinite swept airfoil. Calculation of the drags for such an airfoil indicated encouragingly low drags and a wind tunnel model simulating a long swept airfoil was designed for Mach 2.0 and tested at Mach 2.0 and 2.25 in order to confirm the results of the calculations. Although the measured total drags were somewhat higher than the calculated values, they were respectably low ($C_{D_t} < 1.4 \times 10^{-3}$ at $C_L \cong 0.068$) for upper wing surface only, and it is clear that laminar flow is possible for supersonic wings swept behind the Mach cone. The approximate lift coefficient of 0.068 was determined from measured pressures on the upper surface and an estimated lower surface pressure distribution. Its value was less than predicted, but there is no indication that it could not be increased to a $C_L = 0.09$ or better by increasing the angle of attack or design camber of the airfoil. Calculations indicated that the airfoil would be supercritical (supersonic velocity component perpendicular to the leading edge) at Mach 2.25, but because the lift coefficient was lower than predicted the measured flow was everywhere subcritical at this higher Mach Number, and the measured total drag coefficients ($C_{D_t} < 1.6 \times 10^{-3}$) indicated laminar flow. Author

N65-25567 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

CALCULATION OF COMPRESSIBLE FLOW LOSSES THROUGH SWEPT SUCTION SLOTS

J. Goldsmith *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 509–547 refs (See N65-25560 15-01)

Results of laminar flow experiments performed on a supersonic 36° swept wing model indicated that it might be desirable to consider the influence of the spanwise component of velocity when calculating the losses through swept slots. If the spanwise component of velocity is of importance at 36 degrees of sweep, it certainly is logical that it would be more influential at higher sweep angles. Since a model with a sweep angle of 72 degrees was being designed, an analysis was made to determine the influence of sweep on slot losses. The conclusions derived from this analysis are presented in this report, together with the description of a workable procedure for calculating the compressible flow losses through swept slots. Author

N65-25569 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

STRUCTURAL ASPECTS OF LOW DRAG SUCTION AIRFOILS

J. Wieder and W. Pfenninger *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 794–800 refs (See N65-25560 15-01)

A description of the structure of low drag suction wings is presented, keyed to a generalized high subsonic wet wing. The results of component load tests, corrosion effects, surface irregularities, concentration factors, and the effects on strength and rigidity are discussed. Author

N65-25596*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LOW-SPEED WIND-TUNNEL TESTS OF A LARGE-SCALE INFLATABLE STRUCTURE PARAGLIDER

Berl Gamse, Kenneth W. Mort, and Paul F. Yaggy Washington, NASA, Jun. 1965 32 p refs
(NASA-TN-D-2859) CFSTI: HC $2.00/MF $0.50 CSCL 01C

The full-scale model paraglider, used to develop a recovery system for capsule-type spacecraft, was designed and constructed to be suitable for flight testing after the wind-tunnel tests. It had a leading-edge sweep angle of 55°, a sail flat pattern sweep angle of 52.5°, and a keel length of 30 feet. Test results reported are concerned with the performance and longitudinal aerodynamic characteristics of the paraglider. The maximum lift-to-drag ratio obtained was about 4.0. The minimum angle of attack which could be obtained was limited by severe oscillations of the wing. Sometimes maximum loading conditions were limited by similar oscillations. Aeroelastic deformations of the wing and suspension system caused significant changes in the aerodynamic characteristics. The maximum load sustainable without buckling varied under repeated loadings. These aeroelastic characteristics would be difficult to predict because of the inelastic load-deformation properties of the materials from which the structure is made. Author

N65-25759# Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering
THE STRUCTURE OF TRAILING VORTEX SYSTEMS BEHIND LIFTING SURFACES Semiannual Progress Report, 31 Mar.–30 Sep. 1964
25 Sep. 1964 6 p
(Contract DA-31-124-ARO(D)-149)
(SAPR-2; AD-461039)

For predicting the amount of circulation contained in the trailing vortex as a function of the vortex position downstream of the wing, a computer program has been evolved which calculates the asymptotic roll-up of the vortex sheet. Flight tests at varying speeds were made over the large tuft grid positioned along the runway, and still photos and motion pictures were taken in an attempt to define the geometry of the vortex. Although no quantitative data resulted, it is believed that a general idea of the area on the tuft grid affected by the vortex can be obtained. Wind tunnel models of the L-19 wing and the Piper Cherokee were completed, and preliminary wind tunnel testing was undertaken. M.G.J.

N65-25946# RAND Corp., Santa Monica, Calif.
OPTIMUM HYPERSONIC LIFTING SURFACES CLOSE TO FLAT PLATES
J. D. Cole and J. Aroesty Mar. 1965 11 p refs
(P-3094; AD-613327)

A two-dimensional lifting surface possessing maximum lift to drag ratio for fixed lift in the limit of inviscid hypersonic flow was investigated through analysis of the lower surface of a lifting airfoil which is close to a flat plate in shape. The first order pressure correction due to the perturbation of a wedge profile in supersonic flow as given by Chernyi was applied to find the pressure distribution, when referred to the pressure on a simple flapped surface which is superior to a flat plate surface. G.G.

N65-25954# Naval Postgraduate School, Monterey, Calif.
SKIN FRICTION DRAG AND SHEAR STRESS DISTRIBUTION ON SEVERAL STREAMLINED BODIES OF REVOLUTION WITH VARIED FINENESS RATIO
Cleveland L. Dunning, Robert F. Overmyer, and Colben K. Sime, Jr. (M.S. Thesis) 1964 148 p refs
(AD-614237)

Experimental techniques were employed to determine the coefficient of skin friction drag and the distribution of local frictional intensity for several low drag bodies of revolution with mixed laminar and turbulent flow. The data were obtained as a function of fineness ratio and Reynolds number from experiments conducted in the U. S. Naval Postgraduate School subsonic wind tunnel under conditions equivalent to incompressible flow. Skin friction drag coefficients were determined first by the indirect method of subtracting pressure drag from total drag. A second more direct method was the determination of local sheer distributions and integration over the surface area to obtain total frictional drag. The possibility of inaccuracies introduced by assumptions and agreement between results of the two methods are discussed. Author

N65-25959# Toronto Univ. (Ontario). Inst. of Aerospace Studies
AN EXPERIMENTAL INVESTIGATION INTO THE SHAPE OF THRUST AUGMENTING SURFACES IN CONJUNCTION WITH COANDA-DEFLECTED JET SHEETS, PART II
T. Mehus Jan. 1965 63 p refs
(Grant DA-TC-44-177-G1)
(UTIAS-TN-79; AD-614617)

The present work is a continuation of the experimental investigations described in Part I. The subject was to increase the thrust augmentation of a configuration consisting of a Coanda surface (quadrant), deflecting the primary jet sheet through 90°, in conjunction with additional (thrust augmenting) surfaces. The effect of a horizontal and vertical gap between the lip of the nozzle and the leading edge of the deflection surface, as well as the effect of a gap between its trailing edge and the downstream diffuser wall (tertiary flow) was studied. These experiments were carried out for a convergent (subsonic) and a convergent-divergent (supersonic) nozzle at various pressure ratios. The subsonic jet sheet produced the highest thrust augmentation. Tilting of the quadrant led to an increase in the augmentation ratio (excluding the lift acting on the nozzle), while the total thrust augmentation (including the lift over the nozzle) did not increase. Typical secondary and exit mixed flow velocity profiles were obtained. The highest total thrust augmentation observed was 1.37. Author

N65-26037# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
A PROGRAMME FOR THE CONSTRUCTION OF A "FIRST CHARACTERISTIC" FLOW AROUND A CONE WITH OR WITHOUT INCLINATION
J. Maadsam and P. J. Zandbergen Aug. 1963 26 p refs
(NLR-TR-G.32)

This report gives a programme for the determination of the flow around a circular cone. Both the cases of zero-inclination and of a small inclination have been considered. The programme is written in the international machine language ALGOL and can therefore be operated on any computer having an ALGOL compiler. The purpose of this investigation was mainly to provide an accurate solution for these conical flows in view of their application as initial data along a "first characteristic". These data will enable the determination of the flow field around an axially symmetric configuration having a nose contour which may be considered as conical along a certain distance from the vertex. The programme is discussed in detail and some results obtained by it are included as an example. Author

N65-26234# Army Missile Command, Huntsville, Ala. Advanced Systems Lab.
TABULATED STABILITY DATA FOR A SERIES OF RING TAIL BODY CONFIGURATIONS AT MACH NUMBERS FROM 0.8 TO 4.5
Donald V. Rubin Apr. 1965 69 p refs
(RD-TR-65-6; AD-464305)

The static stability characteristics of ring tails on a body of revolution has been investigated during a series of wind tunnel tests. Mach numbers varied from 0.8 to 4.5, and ring diameters varied from 1.25 to 2.50 calibers. This report presents a tabulation of the basic results obtained from the tests. Author

N65-26258*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

RELATIONSHIP BETWEEN THE AERODYNAMIC DAMPING DERIVATIVES MEASURED AS A FUNCTION OF INSTANTANEOUS ANGULAR DISPLACEMENT AND THE AERODYNAMIC DAMPING DERIVATIVES MEASURED AS A FUNCTION OF OSCILLATION AMPLITUDE

Bass Redd, Dennis M. Olsen, and Richard L. Barton Washington, NASA, Jun. 1965 18 p refs

(NASA-TN-D-2855) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A method is presented which relates the aerodynamic damping derivatives as a function of instantaneous angular displacement with the aerodynamic derivatives as a function of oscillation amplitude. Each derivative is expressed in a power series, and by applying the Kryloff-Bogoliuboff equivalent linearization technique, the solution is obtained by equating like coefficients. It is assumed that the damping per cycle is small, the damping coefficient is symmetrical, and the pitching moment is linear. Comparisons with numerical integration results show no appreciable error. The effect of a nonlinear pitching moment is considered for a representative case and is found to be small except when approaching unstable trim.

Author

N65-26261# Aerodynamische Versuchsanstalt, Göttingen (West Germany).

TABLES OF THE AERODYNAMIC DERIVATIVES OF AN OSCILLATING PROFILE WITH CONTROL-SURFACE AND TAB [TABELLEN DER AERODYNAMISCHEN DERIVATIVA DES SCHWINGENDEN STRECKENPROFILS MIT KNICKEN UND STUFEN]

H. G. Küssner and H. Göllnitz May 1964 193 p refs In GERMAN; ENGLISH summary

(DLR-FB-64-05) Available from Zentralstelle für Luftfahrtdokumentation und Information (ZLDI), Munich: 36.50 DM

A survey of the two-dimensional lifting surface theory is given. The oscillating profile with control surface and tab is substituted by a track of straight lines with edges and steps. Its motion is decomposited into six components. The aerodynamic derivativa of this substitutive system for two-dimensional incompressible flow have been calculated and tabulated according to the formulas of H. G. Küssner and L. Schwarz for different values of control surface and tab chord and for different reduced frequencies. The use of the tables is explained by examples.

Author

N65-26268# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe

CONSIDERATION OF RANDOM SIDE FORCES IN THE CASE OF SOLID PROPELLANT POWER UNITS [BETRACHTUNGEN UBER WILLKURLICHE QUERSCHUBKOMPONENTEN BEI FESTSTOFFTRIEBWERKEN]

W. Buschulte and K. Schadow 25 Jan. 1965 35 p refs In GERMAN; ENGLISH summary

(DLR-FB-65-06) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 8.50 DM

The trajectory of missiles may be influenced by lateral components of thrust; these forces are normal to the axis of the missile. Gold flow tests in a transparent model chamber show that random side forces in the case of nozzles without jet-separation in the divergent part of the nozzle are due to non-symmetric flow in the subsonic part of the combustion chamber and the nozzle. This statement is confirmed by direct measurements of lateral forces during rocket motor firings. The non-symmetries upstream the nozzle throat are caused by thermodynamic and chemical phenomena. To reduce the lateral forces a special nozzle has been developed.

Author

N65-26407*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Aerodynamic Facilities Section

MAXIMUM MODEL-SIZE DETERMINATION AND EFFECTS OF THE STING DIAMETER ON AN ENTRY SHAPE AND SPHERE FOR LOW SUPERSONIC MACH-NUMBER TESTING

J. G. Herrera 30 Oct. 1964 57 p refs

(Contract NAS7-100)

(NASA-CR-63429; JPL-TM-33-191) CFSTI: HC $3.00/MF $0.75 CSCL 01A

This Report describes the experimental determination of the maximum-size entry shape that could be tested at a low supersonic Mach number in the 20-in. wind tunnel at the Jet Propulsion Laboratory (JPL). In addition basic aerodynamic sphere data, to supplement existing data, and the effect of sting diameter on the aerodynamic characteristics are included. Tunnel blockage is discussed, and base flow data are presented.

Author

N65-26432# Aeronautical Research Council (Gt. Brit.)

LIST OF CURRENT PAPERS, NUMBERS 601–650

London, HMSO, 1964 6 p refs

(ARC-CP-650) HMSO: 1s 6d

A bibliography on current aerodynamic research papers is presented.

R.N.A.

N65-26459# Royal Aircraft Establishment, Farnborough (England).

THE LIFT, DRAG AND PITCHING MOMENT OF THREE UNSWEPT WINGS OF ASPECT RATIO 3.5, AND TAPER RATIO 0.5, WITH DIFFERENT WING SECTIONS, AT TRANSONIC AND SUPERSONIC SPEEDS

J. B. Scott-Wilson (Natl. Aeron. Estab.) London, Min. of Supply, Sep. 1955 64 p refs

(RAE-TN-AERO-2387)

Three wing-body combinations, with unswept wings of aspect ratio 3.5, and taper ratio 0.5, but with different wing sections, have been tested at transonic and supersonic speeds in the N.A.E. 3 ft wind tunnel. The wing sections used were a 6% R.A.E. 104 section, a 4% R.A.E. 104 section, and a 4% biconvex section. Lift, drag, and pitching moment results are presented without analysis for these models, both with, and without a high set tail-plane. A range of Mach numbers from 0.70 to 1.02 was investigated using the transonic working section. The supersonic results were obtained at Mach numbers of 1.42, 1.61, and 1.82. The Reynolds number of the transonic tests was 1.89×10^6, and of the supersonic tests 1.76×10^6 at $M = 1.42$ and $M = 1.61$, and 1.56×10^6 at $M = 1.82$.

Author

N65-26460# Royal Aircraft Establishment, Farnborough (England).

A SIMPLE METHOD FOR CALCULATING THE SPAN AND CHORDWISE LOADINGS ON THIN SWEPT WINGS

D. Küchemann London, Min. of Aviation, Aug. 1950 51 p refs

(RAE-AERO-2392)

The method applies to winds with symmetrical aerofoil sections in incompressible potential flow, and is based on a new formula for the chordwise lift distribution at the centre of swept wings which is more appropriate than the well known flat plate distribution. This formula has been suggested from a theoretical analysis of the downwash distribution at the centre section of a swept wing of infinite aspect ratio. It leads to a value for the basic lift slope (excluding trailing vortices) varying with

angle of sweep and different from the usual "two dimensional" value of $2\pi \cos \phi$. Thus the value of the basic lift slope varies along the span, and the ordinary integral equation of Prandtl is used to determine the effect of the trailing vortices on the spanwise loading. The calculations give good agreement with experimental values of both spanwise and chordwise loadings on a wide range of planforms and also, in the few cases where comparison is possible, gives reasonable agreement with other methods of calculation. The actual time for working out an example is about one or two hours and is only a fraction of that required for any other method of calculation. The main uncertainties in the calculation of the loading on swept wings would at present, appear to be in determination of the effect of the finite thickness of the aerofoil and of the boundary layer on the lift. The method is extended to the design of swept wings with given span and chordwise load distributions by modifying either the planform or the camber and twist of the wing. Author

N65-26461# Royal Aircraft Establishment, Farnborough (England).

SOME OBSERVATIONS OF THE FLOW OVER A DELTA-WINGED MODEL WITH 55° LEADING EDGE SWEEP, AT MACH NUMBERS BETWEEN 0.4 AND 1.8

E. P. Sutton Nov. 1955 39 p refs
(RAE-TN-AERO-2430)

A delta-winged model, with 54.8° leading edge sweep and a 6% thick RAE 101 section, has been tested in the NAE 3-foot tunnel. The results of lift and pitching moment measurements at Mach numbers from 0.70 to 1.02 and from 1.42 to 1.82 are presented and discussed with the aid of surface oil flow observations. The Reynolds number of the tests was between 2.2 and 3.3×10^6. At Mach numbers up to at least 1.07 a leading edge separation vortex sheet formed on the wing at incidence. An interaction between the vortex sheet and the wing upper surface shock wave at Mach numbers just below one caused unsteadiness of the forces on the model and a pitch-up. At Mach numbers from 1.42 to 1.82 the flow was attached at the leading edge, and an oblique shock lay across the upper surface of the wing. Author

N65-26463# Royal Aircraft Establishment, Farnborough, (England).

AN EXPERIMENTAL INVESTIGATION OF THE TRANSONIC FLOW OVER AN UNSWEPT WING OF ASPECT RATIO 3.5, TAPER RATIO 0.5, WITH A 4% BICONVEX SECTION

J. B. Scott-Wilson (Natl. Aeron. Estab.) London, Min. of Supply, Nov. 1955 37 p refs
(RAE-AERO-2566)

The results of force measurements and surface oil flow studies on a wing-body combination with an unswept wing of aspect ratio 3.5, taper ratio 0.5, and a 4% biconvex section, are analysed. The tests were made at Mach numbers from 0.72 to 1.02, at a Reynolds number of 1.89×10^6. At four Mach numbers, 0.70, 0.80, 0.93 and 0.96, a picture of the flow development with incidence is built up, based on the oil flow patterns on the wing, and a correlation is established between changes in overall forces, and changes in the flow development. At other Mach numbers the flow development is inferred from the overall forces by means of this correlation, and, in this way, an attempt is made to show how transonic flow develops over the wing. At transonic Mach numbers four phases in the development of the flow with incidence, are found. These are (a), no shock-induced separation, (b), shock-induced separation, with the shock roughly stationary on the wing, (c), shock-induced separation, with a rapid forward movement of the shock, and (d), leading edge separation. The aerodynamic derivatives are found to assume roughly constant values in each phase, and their variation with phase and Mach number is considered.
Author

N65-26464# Royal Aircraft Establishment, Farnborough (England).

AN INVESTIGATION OF THE FLOW OVER A HALF-WING MODEL WITH 60.5° LEADING EDGE SWEEPBACK, AT HIGH SUBSONIC AND SUPERSONIC SPEEDS

F. O'Hara and J. B. Scott-Wilson (Natl. Aeron. Estab.) London, Min. of Supply, Nov. 1955 59 p refs
(RAE-AERO-2567)

Pressure measurements and surface oil flow observations have been made in the N.A.E. 3 ft tunnel on a half-wing model with 60.5 degrees leading-edge sweepback, of aspect ratio 2.828, taper ratio 0.333 and section 6 per cent RAE 101, at Mach numbers 0.81, 1.42, 1.61 and 1.82. The results at M = 0.81 show characteristics typical of subsonic flow over a swept wing, including leading-edge separation and a part span vortex; a physical picture of this type of flow, based on the results, is suggested. The results at supersonic speeds show a number of essentially transonic characteristics, including wing shocks and shock induced separation; their presence is consistent with the assumption that the flow depends to some extent on conditions normal to the leading-edge. From a limited analysis of the results, the pressure ratio across the shock for separation is in approximate agreement with the value for two dimensional flow determined by Pearcey. The possibility of reliable assessment of flow characteristics using the oil flow method is confirmed by the close correspondence found between the flow indications from surface oil patterns and from pressure measurements.
Author

N65-26465# Royal Aircraft Establishment, Farnborough (England).

THE RESPONSE OF SLENDER AEROPLANES TO SIDE-GUSTS, AND MEANS FOR ITS SUPPRESSION

B. Etkin London, Min. of Supply, Apr. 1959 44 p refs
(RAE-TN-AERO-2611)

Slender aeroplanes (aspect ratio about unity) are relatively much more sensitive to side gusts than aeroplanes of high aspect ratio; and the critical condition occurs at the lowest speed. The response of a representative configuration in low speed flight was studied; it was found that, when the controls are fixed, the angle of bank in transient or random gusts is several times greater than the sideslip angle associated with the gust. Means are discussed for suppressing the response by using the aeroplane's control surfaces, and the simple roll damper is examined in some detail. This device is found to effect large reductions in the response with practical values of the control-loop gain. Transient and spectral analyses were in quantitative agreement on the effect of the damper. The influence of wide variations in the aerodynamic parameters was studied, and only the rolling moment derivatives l_v, l_p, l_ξ were found to be important. The characteristic time of the control system was varied from the small values appropriate to an autopilot to the large values characteristic of human pilots. Human control can provide results almost as good as an autopilot. Author

N65-26632*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AND SUPERSONIC EJECTION RELEASE CHARACTERISTICS OF SIX DYNAMICALLY SCALED EXTERNAL-STORE SHAPES FROM AN 0.086-SCALE MODEL OF A CURRENT FIGHTER AIRPLANE

William F. Hinson Washington, NASA, Dec. 1959 55 p ref
(NASA-TM-X-128) CFSTI: HC $3.00/MF $0.50 CSCL 01A
(Declassified)

An investigation has been made to determine the capability of a current fighter airplane to satisfactorily eject external stores at transonic and supersonic speeds. These stores include a bomb of fineness ratio 8.33 (bomb 1), a bomb of fineness ratio 7.57 (bomb 2), a weapons pod of fineness ratio

9.20, a pylon-mounted fuel tank, a pylon, and a wing-tip mounted fuel tank. Satisfactory releases were obtained with bomb 1 (free-stream Mach number of 1.98 and high altitudes) and with bomb 2 (free-stream Mach number of 0.9 and low altitudes). Unsatisfactory releases were obtained with the basic body configuration of the weapons pod at a free-stream Mach number of 1.39 and high altitude. However, a satisfactory release, at the same conditions above, was obtained by the addition of a horizontal-tail fin. At a free-stream Mach number of 1.39, clean separation was obtained with an empty wing-tip tank (high altitude) and with an empty pylon tank (high altitude). At low altitude the pylon tank experienced large negative pitch angles in the immediate vicinity of the airplane model. This caused the tail of the pylon tank to remain close to the wing trailing edge for approximately 25 milliseconds (model scale) after release. Clean pylon separation was obtained at high subsonic speeds (low altitudes) and supersonic speeds (high altitudes). After release the pylon experienced erratic motions, but at no time came close to striking the airplane model. Author

N65-26633*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A WIND-TUNNEL INVESTIGATION OF THE CARRY LOADS AND MUTUAL INTERFERENCE EFFECTS OF 1/40-SCALE MODELS OF THE X-15 AND B-52 AIRPLANES IN COMBINATION

Robert T. Taylor and William J. Alford, Jr. Washington, NASA, Dec. 1959 135 p refs

(NASA-TM-X-184) CFSTI: HC $4.00/MF $1.00 CSCL 01A (Declassified)

A wind-tunnel investigation has been made of the aerodynamic characteristics of a North American X-15 model and of a Boeing B-52 model under conditions simulating launching of the X-15 from the B-52. Buffeting data also were obtained on the right-hand horizontal-tail panel of the B-52 model behind the X-15 model installation. The data are presented without analysis; however, the reader is directed to NASA Memorandum 6-8-59L which offers a brief analysis of the X-15 launch problem. Author

N65-26634*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF SEVERAL TAIL CONFIGURATIONS ON THE STABILITY CHARACTERISTICS OF A MIDWING SUPERSONIC-BOMBER MODEL AT MACH NUMBERS OF 1.60, 1.90, 2.20, AND 2.50

R. Franklin Wells and H. Norman Silvers Washington, NASA, Nov. 1960 48 p

(NASA-TM-X-279) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

A midwing supersonic-bomber model was investigated in the Langley Unitary Plan wind tunnel to determine the effect of several tail configurations on longitudinal and lateral stability characteristics at Mach numbers of 1.60, 1.90, 2.20, and 2.50. The fuselage had a fineness ratio of 12.810. The wing had an aspect ratio of 3.20, a taper ratio of 0.40, dihedral of −8° and 21.8° sweep of the quarter chord. The tails consist of two basic types, a T-tail configuration and a low-tail configuration. Various modifications of the T-tail configuration were obtained by the addition of the following components to the basic T-tail: single ventral fin, dual ventral fins, extended nacelles, and wedges on the vertical tail. Two values of dihedral were used on the low horizontal tail, −10° and −30°. In addition, wedges on the vertical tail and rudder deflections were tested with the low-tail configuration. The T-tail configuration exhibited a destabilizing tendency of the pitching-moment-coefficient curve at the higher angles of attack. The low-tail configuration showed no abrupt change in longitudinal stability and the stability tended to be unaffected by Mach number. The T-tail configuration has more effective directional stability at the high angles of attack than the low-tail configuration. Dual ventral fins were more effective than a single ventral fin in increasing directional stability of the T-tail at high angles of attack and high Mach number. Author

N65-26635*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A VARIABLE-SWEEP AIRPLANE CONFIGURATION HAVING A 12-PERCENT-THICK WING AND AN INBOARD PIVOT LOCATION

Ralph P. Bielat and P. Kenneth Pierpont Washington, NASA, Dec. 1960 39 p refs

(NASA-TM-X-429) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

An investigation has been made in the Langley 8-foot transonic pressure tunnel to determine the aerodynamic characteristics of an airplane configuration capable of low-level supersonic attack. The configuration incorporated a variable-sweep wing, and the investigation was made with the wing swept back 16°, 75°, and 94°. The wind-tunnel results indicated that the zero-lift drag rise of the configuration with a maximum wing sweep of 94° was only slightly lower than that for a wing sweep of 75° but the large reduction in lift-curve slope would reduce the gust accelerations. For a wing sweep of 16°, the maximum lift-drag ratio occurred near a Mach number of 0.6. During transition from the low sweep to high sweep, very large changes in aerodynamic center were measured. This large variation in stability for this configuration resulted primarily from the inboard pivot location and the limited amount of fixed area forward of the pivot point. Author

N65-26636*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUBSONIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A 1/30-SCALE CANARD-AIRPLANE MODEL HAVING A WING WITH AN ASPECT RATIO OF 6.0

William B. Igoe, Francis J. Capone, and Richard J. Re Washington, NASA, Jun. 1962 113 p refs

(NASA-TM-X-668) CFSTI: HC $4.00/MF $0.75 CSCL 01A (Declassified)

An investigation has been conducted to determine the longitudinal aerodynamic characteristics of a 1/30-scale, nuclear-powered canard airplane model having a wing with an aspect ratio of 6.0. The model was tested primarily at Mach numbers from 0.60 to 0.92 for an angle-of-attack range of approximately −2° to 20°. The Reynolds number per foot varied from 2.0×10^6 to 4.5×10^6. The effects of end plates mounted as vertical tails, wing leading-edge chord-extension deflection, body filler (model cross-sectional area increased), and boundary-layer transition were studied for the model without the canard surface. Tests of the model with the canard surface were conducted with canard-surface deflection angles of −12° to 8° and with canard-surface tab deflections from −8° to 0° at Mach numbers from 0.60 to 0.85. The model tested was unstable about its selected moment reference center. The test results indicated that the end plates increased the maximum lift-drag ratios up to a Mach number of 0.74 and decreased the model instability at low lift coefficients for all Mach numbers. Deflection of the wing leading-edge chord-extension to 12° resulted in an increase in maximum lift-drag ratio up to a Mach number of 0.75. Trimming the model with the canard surface resulted in a loss of maximum lift-drag ratio, in some cases as much as 2, over that obtained for the untrimmed model without the canard surface. Most of the loss was due to the canard-surface tab deflection required to trim the canard surface. Author

N65-26637*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A 1/30-SCALE SUBSONIC CANARD-AIRPLANE MODEL HAVING A WING WITH AN ASPECT RATIO OF 3.6 AT MACH NUMBERS FROM 0.30 TO 0.98

William B. Igoe, Richard J. Re, and Francis J. Capone Washington, NASA, Jun. 1962 165 p refs

(NASA-TM-X-669) CFSTI: HC $5.00/MF $1.00 CSCL 01A (Declassified)

An investigation of the longitudinal aerodynamic characteristics of a 1/30-scale model of a proposed subsonic nuclear powered canard airplane was made at Mach numbers from 0.30 to 0.98, at angles of attack primarily from −1.5° to 17.5°, and at Reynolds numbers per foot from 2.0×10^6 to 4.5×10^6. The model tested had a wing with an aspect ratio of 3.6, a leading-edge sweepback angle of 51°, and a taper ratio of 0.4. End plates were mounted on the wing tips as vertical tails. The test objectives were to determine the canard-surface loads and effectiveness and the longitudinal stability and performance effects of model components such as deflection of outboard leading-edge chord-extensions, inboard leading-edge camber, wing fences, end plates, and a body filler which increased the maximum cross-sectional area. The test results indicated that the maximum lift-drag ratio of the model was increased by the addition of the end plates at the wing tips. A deflection of the leading-edge chord-extension of 15° was the best chord-extension deflection for high lift stability and for maximum lift-drag ratio. Inboard thickened leading edges, inboard leading-edge camber, and wing fences did not significantly reduce abrupt high lift instability. The maximum lift-drag ratio was no lower for the longitudinally trimmed model with the canard surface and end plates than for the untrimmed model without the canard surface and end plates. Author

N65-26643*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF A FAMILY OF MULTISTAGE MISSILES AT A MACH NUMBER OF 6.0

E. Leon Morrisette and David J. Romeo Washington, NASA, June. 1965 31 p refs

(NASA-TN-D-2853) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation of the aerodynamic characteristics of a series of one-, two-, and three-stage missiles was conducted through an angle-of-attack range from about −2° to 15° at a Mach number of 6. Geometric variables considered were nose shape, flare size and shape, stage fineness ratio and interstage diameter ratio. Experimentally determined values of axial-force, normal-force, and pitching-moment coefficients are compared with calculations based on Newtonian impact theory for a total of 46 configurations. The theory was found to predict satisfactorily the effect of a change in design variables and angle of attack for those configurations without flow separation. In general, the predictions improved with increasing nose bluntness and stage fineness ratio and with decreasing interstage diameter ratio and number of stages. The effects of variation of fineness ratio and interstage diameter ratio were strongly influenced by boundary-layer separation. Regions of flow separation on a relatively small third stage had large effects on the flow over the second stage and resulted in significant variation in the aerodynamic coefficients. Bow-shock impingement on interstage fairing resulted in large increases in axial force and significant deviation from the theory at high angles of attack. Author

N65-26644*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A PARAMETRIC STUDY OF THE AERODYNAMIC CHARACTERISTICS OF NOSE-CYLINDER-FLARE BODIES AT A MACH NUMBER OF 6.0

George C. Ashby, Jr. and Aubrey M. Cary, Jr. Washington, NASA, Jun. 1965 74 p refs

(NASA-TN-D-2854) CFSTI: HC $3.00/MF $0.75 CSCL 01A

Force tests were conducted at a Mach number of 6.0 on nose-cylinder-flare bodies to determine the effect of nose shape, cylinder length, flare angle, and flare length on the longitudinal aerodynamic characteristics. A particular investigation was conducted to determine the effect of flare angle for constant flare length, surface area, and diameter. Results indicated that at a Reynolds number of approximately 0.92×10^6 (based on body diameter), the boundary-layer separation effects were significant only with respect to the slope of the normal-force and pitching-moment curve at low angles of attack. The variations of the aerodynamic characteristics with the various parameters were, in general, similar to those predicted by Newtonian theory below a flare angle of 30° and a ratio of flare base diameter to cylinder diameter of less than approximately 2.2. The limiting diameter ratio is consistent with the extent of the low-constant dynamic-pressure region near the body caused by the bow-shock influences as predicted by axisymmetric characteristic theory. The effects of the various parameters for the flares that exceeded the limiting diameter ratio follow the trends predicted by the computed flow-field properties. The axial force for these flare configurations at zero angle of attack was, in general, computed within 10 percent by using these properties. For a constant flare length and surface area the flare effectiveness increased with increasing flare angle; however, for constant flare diameter only the axial-force coefficient was affected by flare angle. Author

N65-26649*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF BLAST LOADING ON AN AIRFOIL IN MACH 0.7 AIRFLOW WITH INITIAL ANGLE-OF-ATTACK CHANGE OF 28°

James C. Manning Washington, NASA, Jun. 1965 27 p refs

(NASA-TN-D-2876) CFSTI: HC $1.00/MF $0.50 CSCL 01C

An experimental investigation has been completed to examine the blast loading imposed on an airfoil in Mach number 0.7 flow by a blast wave which caused an initial change in angle of attack of approximately 28°. Pressure distributions along one chord of the airfoil at intervals of 0.1 millisecond show the initial diffraction of the blast wave around the airfoil, whereas subsequent distributions at intervals of 0.5 millisecond show the progress along the chord of a leading-edge vortex formed in the diffraction period. Normal-force coefficients obtained from the pressure distributions were substantially greater than those from a wind-tunnel investigation, but were well correlated with those from a previous blast-loading investigation at an initial angel-of-attack change of 18.8° Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-25587*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
V/STOL CHARACTERISTICS IN RELATION TO TERMINAL REQUIREMENTS
Joseph W. Wetmore [1965] 24 p refs Presented at Natl. Transport Eng. Conf. of the Am. Soc. of Civil Engr., Minneapolis, 19-20 May 1965
(NASA-TM-X-56535) CFSTI: HC $1.00/MF $0.50 CSCL 01B

Effective use of V/STOL aircraft in the air-transport system, require special terminals and support facilities which do not presently exist. The location and design of these terminals, or V-ports, will be governed by land and construction costs, convenience of the using public, acceptability to the neighboring communities, and the operational capabilities and limitations of the aircraft. The operational characteristics of V/STOL aircraft as they might influence the terminal requirements are considered, particular consideration given to takeoff and landing characteristics, noise propagation, downwash characteristics, sensitivity to wind, and instrument-flight factors. Two hypothetical V/STOL transports, one powered by a turboprop system and the other by a jet system, are described. The V/STOL aircraft characteristics are discussed in relation to a hypothetical terminal arrangement. Author

N65-25725*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
OPERATIONAL EXPERIENCE WITH THE X-15 REACTION CONTROL AND REACTION AUGMENTATION SYSTEMS
Calvin R. Jarvis and Wilton P. Lock Washington, NASA, Jun. 1965 50 p refs
(NASA-TN-D-2864) CFSTI: HC $2.00/MF $0.50 CSCL 01D

Control of the X-15 during flight at low dynamic pressures was satisfactory with the manual acceleration command reaction controls. During the early stages of reentry, however, the control task was complicated by aerodynamic forces. The addition of a reaction augmentation system made the task easier. Although proportional controls were designed into the X-15 reaction control system, the pilot generally used them as on-off controls. The problems encountered during the development of the reaction control system resulted from an unsuitable application of aluminum components in the hydrogen-peroxide system. Aircraft structural vibration necessitated the addition of an electronic filter to the electronics assembly of the reaction augmentation system. Author

N65-25741# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT IN-FLIGHT HEATING
L. G. Raykov 11 Mar. 1962 122 p refs Transl. into ENGLISH from the book "Nagrev Letatel'nykh Apparatov v Polete" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1962 p 1-100
(FTD-MT-64-269; AD-613548)

In this book the basic questions of aerodynamic heating of supersonic aircraft are expounded and peculiarities of structures brought about by this heating are considered. The author mentions sources of heating of aircraft, determination of temperature fields of supersonic aircraft, rockets and spaceships an example of satellites, the properties of materials at high temperatures and presents data on new materials and coverings able to sustain increased thermal loads. A significant place in this work is occupied also by questions of durability of structures of aircraft in conditions of high temperatures. Furthermore, the book mentions how, on the basis of correct analysis and manifold calculation of phenomena of aerodynamic heating, it is possible to create corresponding efficient designs. Explanations are illustrated by examples of designs of supersonic aircraft and rockets, and also engines of different systems and equipment. Author

N65-26005# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL PROGNOSES OF AIRCRAFT BUMPINESS BY A DEFINED RICHARDSON CRITERION
M. V. Zavarina and M. Z. Yemel'yanova 26 Mar. 1965 12 p refs Transl. into ENGLISH from Materialy Nauchn. Konf. po Aviats. Meteorol. (USSR), 1963 p 53-58
(FTD-TT-64-1032/1; AD-614016)

To determine whether a synoptic meteorology method can be used to predict turbulence in aircraft flight, measurements were compared with the conditions experienced by pilots in a number of actual flights. The method involves calculation of an improved form of Richardson's number, which is a function of observed temperature gradient and average temperature in the layer of flight, and of the dry and moist adiabatic temperature gradient. A critical value was selected such that a calculated number in excess of it is said to indicate bumpy flight conditions. Comparison of calculations with pilots' observations indicate that the method is most successful in the lower tropospheric layer for propeller aircraft at altitudes not above 3.5 km, but less so for jet and turbojet aircraft in the upper troposphere. Of all instances in which bumpiness was predicted, in 26% no bumpiness was observed. Prognosis of the absence was justified in more than 90% of the cases, with best results for flights beyond the clouds. J.M.D.

N65-26032# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT Quarterly Technical Progress Report, 16 May-15 Aug. 1964
Oct. 1964 138 p
(Contract DA-44-177-TC-715)
(QTPR-11; AD-461455)

Progress on the development of the XV-5A lift fan flight research aircraft is reported. The lateral control investigation and static load test were completed. Aircraft number 2 was modified for the vertical thrust stand and flight testing verified the increased lateral control power. The lift fan inlet vanes failed during wind tunnel tests and modifications were made and tested to establish a flight envelope. Potential longitudinal trim problems were noted during wind tunnel testing. A horizontal tail slat and an instrumentation boom for measuring tail angle of attack were designed and installed on aircraft number two. The nose wheel shimmy studies were completed and initial hover flight begun. A J85 stall investigation was conducted as a result of several compressor stalls during flight testing. Two hover flights were successfully completed without stalls using J85s in a stall-free configuration. R.N.A.

N65-26270# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugmechanik
DIFFERENT EVALUATIONS OF THRUST [BERECHNUNG DER ROLLSTRECKE FUR VERSCHIEDENEN SCHUBVERLAUF]
H. Herb and R. Ludwig 15 Jan. 1965 25 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-08) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich. 7.50 DM

When calculating the ground run distance of an airplane, a linear decrease with velocity is set up for the thrust (for higher speeds only, a quadratic value must possibly be added). The results are represented as nomographs, where the aerodynamic values, air density, and the friction coefficient are given and wing load, static thrust load, and thrust parameter are variable. Author

N65-26298# Cornell Univ., New York. Daniel and Florence Guggenheim Aviation Safety Center
SURVEY OF RESEARCH PROJECTS IN THE FIELD OF AVIATION SAFETY Annual Supplement
1965 92 p refs

A survey of research projects in aviation safety is presented which includes projects in the areas of accident prevention and protection, air transportation, aircraft instruments, aircraft design, airports and airways, aviation medicine, education and training, electronics, electrical equipment, fuels and lubricants, materials, meteorology, military operations, navigation, operating problems, power plants, rotary wing aircraft, and structures. Important areas of aviation safety in need of further development are discussed and include airport and navigational aids, turbulence and loss of control, emergency evacuation, safety economics, crash fire protection, weather information, V/STOL development, general aviation, collision avoidance, and component reliability. R.N.A.

N65-26313# Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 18, 1–31 May 1964
A. J. Marchese 15 Jun. 1964 22 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933018; AD-460983)

Progress is reported on the development of the X-22A tri-service V/STOL aircraft. Nearly all of the design drawings have been released for fabrication. The aircraft weight has remained within target tolerances. Scale model preparation and testing are continuing. Final acoustic tests on the new test specimen to finalize damping material requirements are progressing satisfactorily. Systems are continuing to be installed in the propulsion test stand and the flight control and hydraulic test stand. Final wing and fuselage assembly is continuing. R.N.A.

N65-26328# Ling-Temco-Vought, Inc., Dallas, Tex.
XC-142A VTOL TRANSPORT PROGRAM Monthly Progress Report, Sep. 1964
L. C. Josephs Oct. 1964 35 p
(Contract AF 33(657)-7868)
(AD-461447)

Progress is reported on the development of the XC-142A VTOL transport. The aircraft was flown for the first time for 38 minutes at an altitude of 10,000 feet, a speed of 150 knots, and with landing gear down throughout the entire flight. Take-off and landings were made with wing and flaps at 10 degrees. Throughout the flight the aircraft demonstrated smooth response and stable aerodynamic characteristics. In addition high speed taxi runs, a 50 hour tie-down test, and a teardown inspection of transmission and propulsion system components were completed. R.N.A.

N65-26575# Harry Diamond Labs., Washington, D. C.
MEASUREMENT OF ELECTROSTATIC CHARGE ON AIRCRAFT
Philip Krupen and Elmer B. Rogers 30 Dec. 1964 28 p refs
(HDL-TR-1267; AD-614060)

The electrostatic charge on airplanes was determined from measurements of the charge induced on a large screen while the airplanes flew over it. The airplane charge was computed from a transfer function that involved the relaxation time of the sensing circuit and the passage time of the airplane. Corrections for variation in the height and displacement of the airplanes were made from laboratory measurements on scale models of the field equipment. The average charge on a jet-propelled F-86 fighter was found to be -35.4×10^{-6} coulomb and on a B-26 bomber, -0.56×10^{-6} coulomb. The corresponding aircraft potentials are approximately $-141{,}000$ and -1200 v.
Author

N65-26650*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SOME NONASYMPTOTIC EFFECTS ON THE SONIC BOOM OF LARGE AIRPLANES
F. Edward Mc Lean Washington, NASA, Jun. 1965 20 p refs
(NASA-TN-D-2877) CFSTI: HC $1.00/MF $0.50

The study of a number of equivalent bodies representing a large airplane at critical transonic flight conditions indicates the possible inapplicability of the asymptotic far-field theory used in current sonic-boom analyses. At these normal operating conditions the pressure field from a large airplane, such as the supersonic transport, tends to exhibit important non-asymptotic near-field characteristics which must be calculated with the use of general theory. Since the shape and magnitude of the near-field pressure signature is dependent on airplane equivalent body shape, suppression of the sonic boom through a design approach to a more idealized near-field shape is suggested. The results of the study indicate that if certain effective area distributions can be achieved by real airplanes, sonic-boom overpressures much lower than those predicted by current asymptotic methods would be possible. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-25639# Oklahoma State Univ., Stillwater Mechanical Engineering Dept.
FATIGUE IN ACTUATORS Final Report
R. E. Little and C. Bacgi [1964] 10 p
(Contract AF 34(601)-17361)
(AD-612904) CFSTI: HC $1.00/MF $0.50

To mitigate fatigue problems in actuators, changes were proposed in MIL-C-5503B. Studies and tests relevant to increasing design integrity were suggested. Fatigue failure exhibits show that these actuators were not designed to withstand fatigue loading. Consequently, fatigue problems will increase as time passes unless a significant preventative program is undertaken. Author

N65-25750# Livingston Electronic Corp., Montgomeryville, Pa.
LIQUID AMMONIA BATTERIES First Monthly Progress Report
15 Oct. 1964 25 p
(Contract DA-28-017-AMC-1542(A))
(Rept.-1; AD-461008) Unclassified report

A power source study is presented on the design and development of three primary reserve, automatically activated batteries, designated A, B, and C, each with its own set of specifications. Battery A single cell parameters were determined, a control performance specification established, and a working cell produced to meet the total energy output requirements. Cell composition and the results of cyclic load and a one ampere drain rate test are given. Battery B single cell parameters and a control performance specification were also determined but were simplified because of the relatively low total energy output. During test runs all activated cells satisfactorily supported the checkout sequence and withstood the activated stand period, but failed to support the operational load schedule. Battery C development was limited to design

activity because of the minimal electrical performance requirements. A design using acceleration force for activation was generated. R.N.A.

N65-25763# Naval Ordnance Lab., White Oak, Md.
PURE FLUID TECHNOLOGY AND POSSIBLE ORDNANCE APPLICATIONS
D. L. Blanchard and C. J. Sewell Mar 1965 37 p
(NOLTR-64-115; AD-612503)

Basic knowledge of pure fluids and investigation of ordnance applications are considered. Basic operation of the bistable amplifier, analogue amplifier, or/nor element, flip-flop, binary counter, and simple oscillator as well as sensors which are either pure fluid or give a fluid signal are discussed. Proposed pure fluid circuits for free fall, tactical missile and ballistic missile applications are included. Author

N65-25836# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center
LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT Quarterly Technical Progress Report, 15 Jan.–15 Apr. 1965
R. L. Hundstad, F. A. Holmes, and M. G. Fey Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 15 Apr. 1965 27 p ref
(Contract AF 33(657)-8311)
(QTPR-11; AD-614458)

The construction and assembly details are described of the closed loop test apparatus. Description, analysis, and design of component parts, and a discussion of power lead materials compatability are included. Author

N65-25862# Westinghouse Electric Corp., Youngwood, Pa. Semiconductor Div.
DENDRITIC SOLAR CELL AND ARRAY INVESTIGATION Interim Progress Report, 1 Dec. 1964–1 Mar. 1965
K. S. Tarneja, ed. [1965] 36 p refs
(Contract AF 33(615)-1049)
(IPR-6; AD-612485)

Development of drift field solar cells, using epitaxial growth techniques and solar cell panel fabrication, and array design studies are discussed. Modifications in the graphite resistance epitaxial system are discussed. Attempts to grow SiO_2 films directly on the diffused cell surface were made. Results of the irradiation series of 1 MeV electrons on A1-doped solar cells are presented. The module and the panel size using the "slotted angle" design have been finalized. Design studies of arrays up to 20 square feet are discussed. Author

N65-26056# Rocketdyne, Canoga Park, Calif.
FEASIBILITY INVESTIGATION OF A MOVING BELT RADIATOR Quarterly Progress Report No. 1, 9 Mar.–9 Jun. 1964
Jul. 1964 139 p refs
(Contract AF 33(615)-1576)
(R-5670-1; AD-461009)

This report covers the first quarter of a continued research program on the feasibility of a novel concept for the rejection of waste heat in space, the moving belt radiator. Chief concerns of the program are materials compatability, thermal conductance, and high-temperature bearings, all in the hard vacuum environment of space. Testing of the compatibility of belt and drum materials, and heat transfer by contact conductance has been continued from the previous program. Tests with a small-scale model and optimization studies of the belt radiator were initiated. Design layout of a 204/210-size bearings tester was completed. Author

N65-26245# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL Final (Ninth) Progress Report, 1 Jun.–31 Oct. 1964
S.-Y. Lee, H. H. Richardson et al Jan. 1965 107 p refs
(Contract AF 33(657)-7535)
(DSR-8998-9; AFFDL-TR-64-193; AD-463892)

This report presents technical results and describes progress in several phases of continuing applied research and development related to the design and development of high-performance fluid control devices for advanced aerospace systems. Continued emphasis is placed on pneumatic components and systems which are capable of performing, with high reliability, over wide ranges of temperature and in the presence of intense radiation. This report describes current work in the Engineering Projects Laboratory dealing with a new pulse actuation servo system, a pneumatic pulse-length-modulated servo system, the dynamics of fluid jet modulators, electrostatic pure fluid modulation, vortex valve characteristic, jet pipe inlet coupling, and the design of pneumatic compensation elements. Author

N65-26250*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATING STABILITY OF THE APOLLO FUEL-CELL CONDENSER
Michael B. Weinstein Washington, NASA, Jun. 1965 24 p refs
(NASA-TM-X-1100) CFSTI: HC $1.00/MF $0.50 CSCL 10A

A ground test evaluation was made of the condensing stability in the small condensing tubes of the Apollo fuel cell condenser. The condenser was operated horizontally in a one-gravity environment and showed no evidence of instability over a wide range of condensate rates. Small differences in the tube to tube condensing modes were averaged out by the large number of tubes to give very stable operation. Motion pictures taken of the condensate emerging from the condensing passages along with traces of the fluctuations in the pressure differential across the condenser show that the condensate flow in the tubes is controlled by surface tension and viscous forces, and that operation in zero gravity does not alter the condenser's operation. R.N.A.

N65-26279# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
POLYNOMIAL GAS FLOW REGULATORS
T. A. Barr and R. F. Mayo 4 May 1965 19 p
(RR-TR-65-6; AD-464305)

The design principles for a gas flow regulator which produces prescribed time dependent mass flow rates of gas are stated. The principles are discussed in terms of a passive system of tanks which are connected in series by sonic throttles. Each tank produces one term of a temporal polynomial. Certain considerations prevent this being made into a practical device. Alternate systems based on the same principles but using programable regulators instead of the tanks are described. One such system was built and tested. It produced a satisfactory sixth-degree polynomial substitute for a prescribed exponentially increasing gas flow rate program for a 600-kilowatt, two-arc plasma facility. Author

N65-26408*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
CYCLE LIFE TEST OF SECONDARY SPACECRAFT CELLS First Annual Report
E. C. Bruess 14 May 1965 205 p
(Contract W-11252B)
(NASA-CR-63424; QE/C-65-356) CFSTI: HC $6.00/MF $1.25 CSCL 10C

Performance characteristics and limitations through life cycle test evaluations of numerous sealed, nickel-cadmium cells

are presented. Cells were arranged in packs of 5 or 10 cells and cycled with a given set of test parameters until more than half of the cells had failed. Observed were: ambient temperature, charge voltage limit, percent depth of discharge, percent of recharge, and the orbit period at 50° C, 50° C followed by subsequent change to 40° C, at 25° C, and at 0° C. A total of 29 of the original 84 packs failed, and the remaining 55 packs completed from 291.1 to 375 days of continuous cycling. It was found that 50 C was in general an unsatisfactory ambient temperature for the specific current and orbit periods. Average initial capacities and average capacities after 264 days of cycling are presented in terms of percent of rated capacity, and show that certain packs exhibit the "memory effect". An appendix describes several tests added to the life cycle test program. G.G.

N65-26576# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
INVESTIGATION OF CdS THIN-FILM SOLAR CELLS Technical Report, Nov. 1963–Dec. 1964
W. W. Baldauf, B. Keramidas, D. Harvey, C. Morano, D. Krus et al Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab. Feb. 1965 122 p refs
(Contract AF 33(615)-1248)
(AFAPL-TR-65-1; AD-613187)

Research and development of front wall, thin film, flexible, light weight CdS solar cells has continued and decided improvements have been accomplished. A one square foot array has shown a power to weight ratio of about 35.0 watts/lb. with an overall area utilization factor of over 0.80. A new chemical barrier formation process has been developed providing higher cell efficiencies. Exposure of cells to electron, proton and Cobalt 60 radiation has shown little or no damage. Studies on the formation of the CdS layer indicate a higher degree of preferred orientation and crystallite size as the substrate temperature increases. Crystallites of 100 micron dimension have been observed. Optical measurements on the p-layer confirm the conclusion that the barrier layer is a highly conducting copper sulfide. Overlayers of SiO deposited on the cell decrease the rate of water vapor degradation, but mechanical imperfections restrict the thickness of the deposited layer. Theoretical analysis of the experimental data show serious and probably insurmountable problems with application of either a surface state or trap model for the CdS solar cell. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-25572# Youngstown Univ., Ohio. Dept. of Chemistry
INVESTIGATION OF THE USE OF BIOCHEMICALS IN TECHNIQUES OF CO_2 SEPARATION AND CONCENTRATION IN AEROSPACE VEHICLE ATMOSPHERE REGENERATION PROCESSES Quarterly Technical Report
George Graf Feb. 1965 132 p refs
(Contract AF 33(615)-1777)
(QTR-3; AD-463567)

Thousand ml. solutions of 0.02-0.2M 2-amino-2-(hydroxymethyl)-1,3-propanediol and 0.01-0.02% by wt. carbonate hydro-lyase were absorbing carbon dioxide from an air stream, containing 1% CO_2 by vol., and passing through the absorber at rates of 500-1000 cc/min. in continuous operation for 90 minutes. The absorption was monitored by an infrared gas analyzer. After absorption, the solutions were regenerated, by keeping them under continuous evacuation, at 30° C. for 60 minutes. The cycles of absorption and regeneration were repeated successively over periods of 33-96 hours, including the idle times during which the solutions were not processed. During these operations the activity of the enzyme remained constant. The absorption patterns indicated that the solutions are regenerable and, at higher buffer concentrations, the solutions absorb more than 65-70% of the carbon dioxide passing through the absorber, over periods longer than 90 minutes. It was established also that higher enzyme concentrations shorten the regeneration time. Author

N65-25582# Oak Ridge National Lab., Tenn. Health Physics Div.
APPLIED HEALTH PHYSICS ANNUAL REPORT FOR 1964
K. Z. Morgan, D. M. Davis, et al Jun. 1965 87 p refs
(Contract W-7405-ENG-26)
(ORNL-3820) CFSTI: $3.00

Gaseous and liquid waste releases from the laboratory resulted in a concentration of radioactive materials in the atmosphere at the perimeter of the controlled area which was less than 1% of the maximum permissible. The number of beta curies released via White Oak Creek to the Clinch River was 234, about half the 1963 release. The average concentration of ^{131}I in raw milk samples was 11.4 pc/l, about 12 percent less than in 1963. Background measurements at five selected locations decreased by a factor of about two from 1963. The average for 1964 was 0.014 mR/hr. No employee received an external or internal radiation dose more than the maximum permissible levels; the highest whole body dose equivalent received by an employee was about 4.2 rem or 35% of the maximum permissible annual dose. During 1964 there were no cases of internal exposure where the deposition of radioactive materials within the body was estimated to have averaged greater than half of a maximum permissible body burden. During 1964 the frequency of unusual occurrences dropped to a five-year low of 29 events. About 50% of these were classified as significant. Revisions in personnel monitoring techniques and development of improved bio-assay procedures have been made. Author

N65-25590*# Brandeis Univ., Waltham, Mass. Dept. of Biochemistry
[A COMPARATIVE STUDY OF THE EVOLUTION OF ENZYMES AND NUCLEIC ACIDS] Semi-Annual Status Report, Nov. 1, 1964–Apr. 30, 1965
Nathan O. Kaplan, Lawrence Levine, and Lawrence Grossman [1965] 3 p
(Grant NsG-375)
(NASA-CR-63246) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Developments are reported in a comparative study on enzyme and nucleic acid evolution. The main properties of lactic dehydrogenases from species representing all the vertebrate classes were measured for susceptibility to inhibition by high pyruvate concentration, electrophoretic mobility in starch gel, and temperature stability. An acidic protein was isolated and purified from beef brain and exhibited little evolutionary variation when exposed to antibodies. Antibodies were produced by making the protein immunogenic and complexing it with methylated bovine serum albumin. The antiserum was shown to be immunochemically homogeneous in double diffusion tests in agar with crude beef brain extract and acidic protein as antigens. Experiments in which ultraviolet photoproducts of cytosine act as uracil in RNA polymerase templating systems were completed. R.N.A.

N65-25611# Joint Publications Research Service, Washington, D. C.

SOVIET RESEARCH ON GENETICS AND PHYSIOLOGY

8 Jun. 1965 26 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 160, no. 1–3 1965 (JPRS-30485; TT-65-31196) CFSTI: $1.00

CONTENTS:

1. INTERACTION BETWEEN PHYSICAL AND CHEMICAL MUTAGENS N. P. Dubinin and V. K. Shcherbakov p 1–4 refs (See N65-25612 15-04)

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N65-25612 Joint Publications Research Service, Washington, D. C.

INTERACTION BETWEEN PHYSICAL AND CHEMICAL MUTAGENS

N. P. Dubinin and V. K. Shcherbakov *In its* Soviet Res. on Genet. and Physiol. 8 Jun. 1965 p 1–4 refs (See N65-25611 15-04) CFSTI: $1.00

Simultaneous action of extracts of horse bean seeds and streptomycin on the natural mutation process in root cells during sprouting of podless seeds of *Allium fistulosum L.* clearly demonstrated a protective effect. It was concluded that extracts of horse bean seeds acting on chromosomes altered by streptomycin, acquire a protective instead of a mutagenic action. These facts indicate specific interactions of primary mutagen effects at the chromosome level. G.G.

N65-25613 Joint Publications Research Service, Washington, D. C.

INTERACTION BETWEEN A FRAGMENT OF Hfr CHROMOSOME AND ANNULAR F⁻ CHROMOSOME IN THE PROCESS OF GENETIC RECOMBINATION IN *ESCHERICHIA COLI* K-12

V. V. Sukhodolets *In its* Soviet Res. on Genet. and Physiol. 8 Jun. 1965 p 5–12 refs (See N65-25611 15-04) CFSTI: $1.00

Recombination studies of one pair of genes P and S1A of *Escherichia coli* K-12 in about 10000 recombination crossings showed that about 54% of the T1 + Str − r recombinations, and 51% of the M + Str − r recombinations were not viable, and that the lengths of segments o–S1A, S1A–P, and P–T1 were about 34.9, 8.3, and 33.9 units of recombination, respectively. The importance of the effect of the fragmented edge on length estimations in recombination units of short segments is pointed out. G.G.

N65-25614 Joint Publications Research Service, Washington, D. C.

THE RELATIONSHIP BETWEEN THE RATE OF CHROMOSOMAL ABERRATIONS AND INTENSITY OF IRRADIATION AND HUMIDITY OF SEEDS

N. I. Nuzhdin and K. A. Filev *In its* Soviet Res. on Genet. and Physiol. 8 Jun. 1965 p 13–17 refs (See N65-25611 15-04) CFSTI: $1.00

The influence of intense irradiation on the rate of chromosomal aberrations following irradiation of barley seeds of varying degrees of humidity is discussed. Humidity was determined prior to irradiation of the seeds, which afterwards were soaked, together with controls, for 3 hrs past exposure and then set to sprout. Percentage counts of the anaphase and early telophase of the first mitotic division in the root cells, determined the radiation effectiveness. It was found: (1) Different intensities of equal irradiation dosage led to different production rates of chromosomal aberrations. (2) Manifestations of the effect of the dose strength were not related to the degree of humidity of the irradiated seeds. (3) Irradiated seeds of lower humidity had a lower percentage of aberrations caused by the radiobiological effect. Humidity and irradiation intensities influenced the type of aberration formed, with a more pronounced increase of cells with fragments at high radiation intensity and humidity, and prevalence of cells with bridges at low radiation intensity and the same humidity range. G.G.

N65-25615 Joint Publications Research Service, Washington, D. C.

CHANGES IN THE MACROSTRUCTURE OF BLOOD PROTEINS DURING EXCITATION OF THE CENTRAL NERVOUS SYSTEM

A. F. Makarchenko, B. A. Roytrub, and R. S. Zlatin *In its* Soviet Res. on Genet. and Physiol. 8 Jun. 1965 p 18–23 refs (See N65-25611 15-04) CFSTI: $1.00

The macrostructure of blood proteins was studied on 6 dogs before and after excitation by 0.5 to 1 gr caffeine per animal. A definite relationship was established between the changes in the functional state of the central nervous system and the macrostructure of peripheral blood proteins. Maximal positive conditioned reflexes coincided with maximal changes in the different blood serum indices. Serum protein binding of adrenalin in vitro revealed a decrease in protein fixing capacity at increased excitation. It was assumed that the macrostructure changes are caused by the union of blood proteins with metabolites of central origin. G.G.

N65-25641# Army Natick Labs., Mass. Radiation Sources Branch

INDUCED RADIOACTIVITY IN FOOD AND ELECTRON STERILIZATION

Richard A. Meyer Apr. 1965 59 p refs

(FD-6; AD-613950)

A survey indicates that food irradiated with 24 MeV electrons contains less than a 5% increase in the radioactivity level over that present before irradiation. Measured amount of activity induced in various foods as a function of initial electron energy is compiled. Isomer activity has not been detected in foods even from irradiation with high energy electrons. An empirical equation was developed to predict the amount of isomer activity produced in a particular food as a function of initial electron energy and dosage. Although activity induced in cans is not a food consumption problem, it can produce a handling problem. Aluminum cans or an aluminized plastic packaging material may be the best solution. Sterilization of food with 24 MeV electrons will produce a slight increase in the activity level of the food. Such an increase is insignificant when compared to the natural activity in food or the 2 to 10 fold increase in activity by the use of certain food additives. No radioactivity is induced in foods up to around 14 MeV. Current research is aimed at determining this threshold value. Author

N65-25647# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

THE LOGNORMAL DISTRIBUTION AND SOME EXAMPLES OF ITS APPLICATION IN THE FIELD OF RADIATION PROTECTION

H. J. Gale Mar. 1965 30 p refs

(AERE-R-4736) HMSO: 5s

Properties of the simple log-normal distribution and methods of estimating its parameters from a set of experimental results are described with examples from the field of radiation protection. Extensions of the distribution to more complicated cases are mentioned. Discussion of relevant details of the normal distribution and of sampling theory is included. Consideration of the use of the distribution is recommended for experimental data which are asymmetrically distributed. Author

N65-25657# Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES, MEDICAL DIVISION RESEARCH REPORT, YEAR ENDING 31 DECEMBER 1964

[1964] 140 p refs

(ORINS-49)

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3. HEMATOLOGIC RESPONSES TO TOTAL-BODY IRRADIATION IN THE HUMAN BEING G. A. Andrews and M. Smyser p 13–16 (See N65-25659 15-04)

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6. EFFECT OF LOCALIZED IRRADIATION ON THE METABOLISM OF BONE-MARROW LIPIDS F. Snyder and Reba Wright p 21–24 refs

7. LIPID CLASSES OF HEMATOPOIETIC AND FATTY BONE MARROW F. Snyder and E. A. Cress p 24–26 ref

8. LIPID METABOLISM IN FATTY AND NONFATTY BONE-MARROW FRACTIONS F. Snyder and E. A. Cress p 26–30 refs

9. EFFECT OF DIETARY FAT AND TOTAL-BODY IRRADIATION ON THE FATTY ACID COMPOSITION OF BONE-MARROW LIPIDS J. N. Bollinger p 31–33 refs

10. FATTY ACID OXIDATION IN IRRADIATED BONE-MARROW CELLS F. Snyder p 34 refs

11. RAPID ELECTRONIC RED BLOOD CELL SIZING AS AN AID IN CLINICAL DIAGNOSIS C. C. Lushbaugh and D. B. Lushbaugh p 35–39 (See N65-25660 15-04)

12. NITROGEN BALANCE IN RADIATION CHIMERAS W. H. Mc Arthur, C. C. Congdon, and A. L. Kretchmar p 40–41 ref (See N65-25661 15-04)

13. CHANGE IN THE PARTITION OF TOTAL-BODY NITROGEN IN IRRADIATION CHIMERAS A. L. Kretchmar, W. H. Mc Arthur, and C. C. Congdon p 42–43 refs (See N65-25662 15-04)

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17. DEPRESSION OF THE PRIMARY IMMUNE RESPONSE BY d1-PENICILLAMINE K. Hubner and N. Gengozian p 49–52

18. HUMAN A- AND B-LIKE ANTIGENS ON RED CELLS OF MARMOSETS N. Gengozian p 52–55

19. HEMATOLOGIC AND CYTOGENETIC EVIDENCE FOR CHIMERISM IN THE MARMOSET, *TAMARINUS NIGRICOLLIS* N. Gengozian, J. S. Batson, and P. Eide p 55–58 ref

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25. ABSORPTION, WHOLE-BODY, AND ORGAN RETENTION OF BIOLOGICALLY IMPORTANT RADIOISOTOPIC MATERIALS p 98–110 refs

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27. COMPUTER PROGRAM FOR CALCULATION OF RESPONSE OF DETECTOR-COLLIMATOR SYSTEMS W. D. Gibbs p 122 ref (See N65-25664 15-04)

28. THERMOLUMINESCENT DOSIMETRY Y. Ja Lee, R. J. Cloutier, and P. Dalton p 123 ref (See N65-25665 15-04)

29. THE WHOLE-BODY SCANNER A. C. Morris, Jr. p 124–126 ref (See N65-25666 15-04)

30. NASA RETROSPECTIVE STUDY ON IRRADIATION EFFECTS p 127

31. RADIOSENSITIVITY IN MAN: A STUDY BASED ON THERAPEUTIC AND ACCIDENTAL EXPOSURE C. C. Lushbaugh, R. Hofstra, R. E. Roth, and G. A. Andrews p 128–131 (See N65-25667 15-04)

32. PROCESSING OF FECES FOR ANALYSIS A. M. Webb and G. C. Kyker p 132 ref

33. AN AUTOMATIC ZONAL SCRAPER AND SAMPLE COLLECTOR FOR RADIOASSAY OF THIN-LAYER CHROMATOGRAMS F. Snyder, H. E. Kimble, and N. Stephens p 133–135 refs (See N65-25668 15-04)

34. PUBLICATIONS 1964 p 136–139 refs

N65-25658 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

INFECTIONS IN PATIENTS EXPOSED TO TOTAL-BODY IRRADIATION

G. A. Andrews, B. W. Sitterson, and Bill M. Nelson *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 11–13 (See N65-25657 15-04)

Twenty-six treatments with total-body radiation, 200- to 940-R midbody air dose, were given to patients with late stages of leukemia and malignancy. Half the patients died within 8 weeks and the causes of death are indicated. Infection was the major cause of early death. Among the patients who survived, a variety of infections was encountered. The prominence of gram-negative infections and fungi is emphasized in this series. Diffuse pulmonary hemorrhage associated with infection was frequent and may be rather characteristic of irradiation injury. N.E.A.

N65-25659 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

HEMATOLOGIC RESPONSES TO TOTAL-BODY IRRADIATION IN THE HUMAN BEING

G. A. Andrews and Mary Smyser *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 13–16 (See N65-25657 15-04)

An attempt is made to establish typical hematological patterns for various doses of total-body irradiation in the previously normal human being. Hematological responses are shown for 100, 200, and 300 rad doses. N.E.A.

N65-25660 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

RAPID ELECTRONIC RED BLOOD CELL SIZING AS AN AID IN CLINICAL DIAGNOSIS

C. C. Lushbaugh and D. B. Lushbaugh *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 35–39 (See N65-25657 15-04)

Red blood cell volume studies made with an electronic cell-volume analyzer unit are presented, and operational techniques of the electronic unit are discussed. The blood pictures of 27 patients who have been studied with the described electronic method which uses high aperture currents are given. N.E.A.

N65-25661 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

NITROGEN BALANCE IN RADIATION CHIMERAS

W. H. McArthur (Knoxville Coll.), C. C. Congdon (Oak Ridge Natl. Lab.), and A. L. Kretchmar *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 40–41 ref (See N65-25657 15-04)

Experiments were undertaken to determine whether overall nitrogen metabolism was abnormal in irradiated mice given isologous or homologous bone marrow cells. The results indicate that nitrogen balance is positive both in animals treated with isologous marrow and in mice given homologous marrow after irradiation. Summarized data show that animals treated with isologous marrow maintain a normal rate of gain in body weight through 90 days, but retain significantly more nitrogen than normal animals. The animals given homologous marrow failed to gain weight but retained twice as much nitrogen as normal mice. N.E.A.

N65-25662 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

CHANGE IN THE PARTITION OF TOTAL-BODY NITROGEN IN IRRADIATION CHIMERAS

A. L. Kretchmar, W. H. McArthur (Knoxville Coll.), and C. C. Congdon (Oak Ridge Natl. Lab.) *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 42–43 refs (See N65-25657 15-04)

Tests were performed to determine if there was a shift in the distribution of body nitrogen in irradiated mice with homologous marrow grafts. Experimental data show that distribution of nitrogen is changed in homologous chimeras and that there is relatively more nitrogen in skin than in carcass, especially in animals of less than 18 g and, therefore, presumably suffering from homologous disease. The data also show that this shift can be detected early (four days) but is probably progressive. Results suggest that a major target of the graft-antihost reaction is the skin and that nitrogen is deposited in this tissue at the expense of the carcass tissues. N.E.A.

N65-25663 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

WHOLE-BODY COUNTERS

A. C. Morris, Jr., C. C. Lushbaugh, R. L. Hayes, H. Kakehi, and W. D. Gibbs *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 111–122 ref (See N65-25657 15-04)

A series of three whole-body counters have been developed for clinical use and are now in operation. Developmental efforts that resulted in the completion of the low-level counter are presented, and operational procedures are given. The diagnostic-level counter is also described. Several experiments were performed to evaluate the uniformity of response and clinical usefulness of the counter, and results indicate that it will be a useful instrument for following whole-body measurements in the diagnostic dose range. It is reported that the high-level whole-body counter continues to be a useful clinical instrument. The recent incorporation of a transistorized spectrometer system has resulted in more stability and easier operation. N.E.A.

N65-25664 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

COMPUTER PROGRAM FOR CALCULATION OF RESPONSE OF DETECTOR–COLLIMATOR SYSTEMS

W. D. Gibbs *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 122 ref (See N65-25657 15-04)

A computer program was designed to calculate the isoresponse and volume response of a detector–collimator system. The program was written specifically for data obtained at 546 points but can be simply generalized for any number of points. This problem was run on an IBM 1620 computer. Computations and readout time required less than 30 minutes. N.E.A.

N65-25665 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

THERMOLUMINESCENT DOSIMETRY

Young Ja Lee, R. J. Cloutier, and P. Dalton *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 123 ref (See N65-25657 15-04)

Thermoluminescent dosimetry is currently being used to measure the dose to patients during total-body irradiation. Tabulated results are presented to show comparison of thermoluminescent dosimetry of three patients given total-body irradiation with ionization chamber measurement of an anthropomorphic irradiated phantom. N.E.A.

N65-25666 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

THE WHOLE-BODY SCANNER

A. C. Morris, Jr. *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 124–126 ref (See N65-25657 15-04)

The whole-body scanner system being developed is essentially complete. This scanner uses a 5-inch thick NaI scintillation detector mounted underneath the patient-supporting bed. The scanner permits the selection of different line spacings ranging between 1/16 inch and 1 1/16 inches, and scanning speeds ranging between zero and 40 inches/minute. The electronic system includes both multidot and photoscan recording. This system also incorporates a selection of separate dot factors for both photoscan and multidot modes of recording. Minor modifications and additional work done on the scanner to improve its efficiency are described. N.E.A.

N65-25667 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

RADIOSENSITIVITY IN MAN: A STUDY BASED ON THERAPEUTIC AND ACCIDENTAL EXPOSURE

C. C. Lushbaugh, R. Hofstra (Oak Ridge Natl. Lab.), R. E. Roth (St. Bonaventure Coll.), and G. A. Andrews *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 128–131 (See N65-25657 15-04)

The case histories of 94 patients who had received total-body irradiation in the course of therapy, or as a result of a criticality accident, were encoded and processed to determine the incidence of anorexia, nausea, and vomiting. The patients were divided into five dosage groups for which geometric mean doses of 49.6, 105.2, 300, 370.3, and 540.5 were determined. The percentage of cases in each group that showed anorexia, nausea, and vomiting are shown. Probability analyses were then done with these data to estimate the total body irradiation dose required to produce the particular response in 50% of the patients. The results are presented in tabulated form. The values are expressed as common logarithm to define the standard deviations of the estimates, and the midline air dose (roentgens), and the absorbed dose (rads) to the gastrointestinal tract. These results appear to indicate that, if it is true that the chance of an astronaut in space receiving 10 rads to the abdomen is less than one in 1000, the chance that radiation-induced severe nausea and vomiting will occur is less than 1:100 000. N.E.A.

N65-25668 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Medical Div.

AN AUTOMATIC ZONAL SCRAPER AND SAMPLE COLLECTOR FOR RADIOASSAY OF THIN-LAYER CHROMATOGRAMS

F. Snyder, H. E. Kimble, and N. Stephens *In its* Oak Ridge Inst. of Nucl. Studies, Med. Div. Res. Rept., Year Ending 31 Dec. 1964 [1964] p 133–135 refs (See X65-25657 15-04)

A scraper-collector is described for zonal radioscanning of thin-layer chromatoplates capable of removing 1-, 2-, or 5-mm zones. Operational techniques are presented, and a graph of zonal scan of I-triolein before and after purification by thin-layer chromatography is shown. N.E.A.

N65-25669# Joint Publications Research Service, Washington, D. C.

SOVIET RESEARCH ON CARDIOLOGY

8 Jun. 1965 34 p refs Transl. into ENGLISH from Kardiologiya (Moscow), v. 5, no. 2, Mar.–Apr. 1965 p 3–21, 84–85 (JPRS-30490; TT-65-31201) CFSTI: $2.00

CONTENTS:

1. CLINICO-INSTRUMENTAL INVESTIGATION OF THE CONTRACTILE FUNCTION OF THE HEART P. Ye. Lukomskiy p 1–13 ref (See N65-25670 15-04)

2. THE VALUE OF ELECTROKYMOGRAPHY IN THE DIAGNOSIS OF MITRAL DISEASE COMPLICATED BY FIBRILLATION M. N. Tumanovskiy, N. M. Shestakov, and V. Ya. Garmash p 14–19 refs (See N65-25671 15-04)

3. THE DYNAMICS OF CARDIAL INSUFFICIENCY IN MITRAL HEART DISEASE ACCORDING TO DATA FROM VENOUS CATHETERIZATION, PUNCTURE OF CARDIAC CAVITIES, FILTRATION PHONOCARDIOGRAPHY AND ELECTROMAGNETIC BALLISTOCARDIOGRAPHY L. T. Malaya, A. A. Shalimov, S. A. Dushanin, and M. M. Lyashchenko p 20–27 refs (See N65-25672 15-04)

4. THE ELECTROOSCILLOGRAPHIC TECHNIQUE I. M. Kakhnovskiy and N. S. Ul'mer p 28–31 (See N65-25673 15-04)

N65-25670 Joint Publications Research Service, Washington, D. C.

CLINICO-INSTRUMENTAL INVESTIGATION OF THE CONTRACTILE FUNCTION OF THE HEART

P. Ye. Lukomskiy *In its* Soviet Res. on Cardiology 8 Jun. 1965 p 1–13 ref (See N65-25669 15-04) CFSTI: $2.00

A brief description of the different methods and instrumentation used in clinical diagnosis of conditions of the myocardium is given. Specifically discussed are the principles and usefulness of the following methods used in assessing the pathological condition of the myocardium: (1) electrocardiography; (2) vectorcardiography; (3) phonocardiography; (4) electrokymography; (5) ballistocardiography; and (6) dilution methods (dye and radioisotope). N.E.A.

N65-25871# Joint Publications Research Service, Washington, D. C.

CHANGES IN RESPIRATION AND REFLEX EXCITABILITY OF THE RESPIRATORY CENTER IN DOGS INHALING OXYGEN

G. A. Vaksleyger 16 Jun. 1965 14 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR Im. I. M. Sechenova (Leningrad), v. 50, no. 3, Mar. 1964 p 280–287 (JPRS-30637; TT-65-31273) CFSTI: $1.00

Data indicated two phases in the effect of increased oxygen content on respiration. For two to eight minutes after inhalation, respiration became more shallow in 88% of the animals. In 82% of the cases, threshold of reflex excitability remained unchanged. The initial reaction was followed by a delayed response, whereby external respiration approximated its original form. Characteristic respiratory changes were also observed after the administration of chloral hydrate and aminazin. There was weakening of thoracic respiration while abdominal respiration remained relatively unchanged, suggesting inhibition of cerebral cortex activity. However, it was found that aminazin does not alter excitability of the respiratory or feeding centers. Experimentation was carried out in a closed chamber, with temperature and pressure constant but ventilation varied. Reflex excitability of the respiratory center was determined by stimulating the trunk of the vagus nerve drawn out in a skin flap on the neck. Length of stimulation was 4 to 10 sec, each stimulation lasting 3 millisec. Immediately after the threshold was determined by minimum coughing effect, oxygen was supplied, then ventilation was stopped, the chamber sealed and the CO_2 was absorbed by a CaO_2 cartridge. M.W.R.

N65-25672 Joint Publications Research Service, Washington, D. C.

THE DYNAMICS OF CARDIAL INSUFFICIENCY IN MITRAL HEART DISEASE ACCORDING TO DATA FROM VENOUS CATHETERIZATION, PUNCTURE OF CARDIAC CAVITIES, FILTRATION PHONOCARDIOGRAPHY AND ELECTROMAGNETIC BALLISTOCARDIOGRAPHY

L. T. Malaya, A. A. Shalimov, S. A. Dushanin, and M. M. Lyashchenko *In its* Soviet Res. on Cardiology 8 Jun. 1965 p 20–27 refs (See N65-25669 15-04) CFSTI: $2.00

A correlation is observed between indices of intracardiac hemodynamics and changes recorded in phonocardiogram (PKG) and electromagnetic ballistocardiogram (BKG). The relationship between the changes in the intracardiac hemodynamics and changes in PKG and BKG in cases of incipient cardiac decompensation (grade 2A) and cases of progression of cardiac decompensation (grade 2B) is described. It is shown that a relationship also exists when cardiac decompensation shifts from grade 2A to 2B. N.E.A.

N65-25673 Joint Publications Research Service, Washington, D. C.
THE ELECTROOSCILLOGRAPHIC TECHNIQUE
I. M. Kakhnovskiy and N. S. Ul'mer *In its* Soviet Res. on Cardiology 8 Jun. 1965 p 28–31 (See N65-25669 15-04) CFSTI: $2.00

A proposed system of recording electrooscillograms is presented. The system consisted of a modified two-channel, inkscribing electrocardiograph with an additional attachment for recording electrooscillograms. A description of the proposed system and its advantages are presented. Comparative recordings of an electrooscillogram and an oscillogram are shown. N.E.A.

N65-25722# Joint Publications Research Service, Washington, D. C.
MICROBIOLOGICAL SYNTHESIS IN INDUSTRY AND PROTEIN BIOSYNTHESIS
8 Jun. 1965 42 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 4, Apr. 1965
(JPRS-30486; TT-65-31197) CFSTI: $2.00

CONTENTS:
1. THEORETICAL AND INDUSTRIAL ASPECTS OF MICROBIOLOGICAL SYNTHESIS N. D. Iyerusalimskiy p 1–12 (See N65-25723 15-04)
2. THE PROBLEM OF PROTEIN BIOSYNTHESIS A. S. Spirin p 13–39 (See N65-25724 15-04)

N65-25723 Joint Publications Research Service, Washington, D. C.
THEORETICAL AND INDUSTRIAL ASPECTS OF MICROBIOLOGICAL SYNTHESIS
N. D. Iyerusalimskiy *In Its* Microbiological Syn. in Ind. and Protein Biosyn. 8 Jun. 1965 p 1–12 (See N65-25722 15–04) CFSTI: $2.00

The synthesizing activities of microorganisms that have practical usage or theoretical application in the industrial synthesis of products are discussed. Industries employ the microbiological method (when applicable) to the production of expensive products when chemical methods of synthesis exceed those of microorganism synthesis, in cases where the microorganism synthesized products can be used without purification or isolation, and when synthesis of certain products is inaccessible to modern chemical technology. Other cases are cited wherein a combination of microbiological and chemical methods have industrial applications. The degree of microorganism synthesis, and the development of effective technological conditions based on profound study of microorganism physiology are discussed. The method of continuous culturing of microorganisms and the principles involved are described. Limiting factors such as enzymatic reactions and the biosynthesis of enzymes are also discussed. N.E.A.

N65-25724 Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF PROTEIN BIOSYNTHESIS
A. S. Spirin *In Its* Microbiological Syn. in Ind. and Protein Biosyn. 8 Jun. 1965 p 13–39 (See N65-25722 15–04) CFSTI: $2.00

A history of the problem of protein biosynthesis and present day concepts of protein biosynthesis are presented. A fundamental scheme of the processes involved in protein biosynthesis is given. Relative to this scheme, the following are discussed: (1) genetic coding of the information, necessary for protein synthesis; (2) storage and reproduction of the coded information; (3) transmission of the coded information from DNA to the ribosomes; (5) the involvement of amino acids in protein biosynthesis; (6) synthesis of protein in the ribosomes; (7) ribosomal structure; and (8) regulatory aspects of protein biosynthesis. N.E.A.

N65-25775# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIATION MEDICINE
A. I. Burnazyana and A. V. Lebedinskogo 23 Feb. 1965 513 p refs Transl. into ENGLISH of the book "Radiatsionnaya Meditsina" Moscow, Gos. Izd. Lit. po At. Nauke i Tekhn., 1963 p 3–372
(FTD-TT-64-1058/1+2; AD-613585)

Discussed are the following topics: *Physics and Dosimetry of Ionizing Radiation*—natural radioactivity and cosmic rays, calculations on tissue dosage, radiation emanating from the human body, metabolism of radioactive isotopes, elimination of radioactive isotopes, and other studies; *Pathophysiology of Radiation Affectations*—effects of ionizing radiation and their characteristics on the various body organs and systems; *Infection and Immunity in Irradiated Organisms*—antibody production and suppression of infections; *Toxicology of Radioactive Substances*—distribution, dynamics, and elimination of radioactive matter; *Pathologoanatomy of Radiation Affectations*—acute and chronic forms of radiation sickness, and injuries caused by radioactive substances; *Chemical Protection Against Ionizing Radiation*—primary physiochemical processes, and chemical protectors and their mechanisms; *Symptomatology and Treatment of Radiation Sickness*—therapy of acute and chronic radiation sickness; and *Acute Radiation Damage to Tissue*—therapy of radiation burns. G.G.

N65-25848# Oak Ridge National Lab., Tenn. Health Physics Div.
STOCHASTIC MODELS FOR THE DISTRIBUTION OF RADIOACTIVE MATERIAL IN A CONNECTED SYSTEM OF COMPARTMENTS
S. R. Bernard, V. R. Rao Uppuluri, and L. R. Shenton Jun. 1965 49 p refs
(Contract W-7405-ENG-26)
(ORNL-3809) CFSTI: $3.00

Simultaneous Stochastic difference equations of random vectors, such as $C_m = \Gamma_m C_{m-1}$, m = 1,2..., in which C_m represents a state of the system at the *m*th stage and Γ_m is a matrix with random elements, were studied. A recursive multivariate functional equation can be set up between the joint characteristic functions of the components in C_m and C_{m-1}. Expressions are derived for the means and covariances of the components of the vector C_m. A continuous model, involving the solution of a system of first order linear differential equations, is studied and solutions derived. The three-compartment model is discussd in full detail. Author

N65-25850# Michigan State Univ., East Lansing. Dept. of Biophysics
[ELECTRICAL CONDUCTIVITY OF PROTEINS IN THE SOLID STATE] Semiannual Status Report, 1 Jun.–1 Dec. 1964
Barnett Rosenberg, Michael R. Powell, Elliott Postow, Gordon Jendrasiak, and Helen Johnson [1964] 13 p
(Contract Nonr-2587(06))
(AD-614440)

Three experimental approaches are described to elucidate properties of the charge carriers in the electrical conductivity of proteins in the solid state. In the first experimental approach, an electrolysis experiment is designed to test the evolution of hydrogen in a solid state as a function of the hydration state of

the protein. In the second part of this experiment, a determination of the conductivity change as a function of the protein (hemoglobin) is considered. The second experimental approach considers how the hydration state of the protein determines the magnitude of the semiconduction process. This is being tested by measuring the dielectric constant of hemoglobin crystals which have been equilibrated with water vapor at specific humidities. In the third experimental approach, the classical technique of the Hall effect is applied to proteins. N.E.A.

N65-25856# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF ALTITUDE ON THE ORGANISM OF FLIERS IN FLIGHT

A. Apollonov and V. Mirolyubov 7 Apr. 1965 18 p Transl. into ENGLISH from Voyenno Sanit. Delo (USSR), no. 7, 1938 p 16–24

(FTD-TT-65-259/1; AD-613584)

Effects of simulated high altitude conditions on fliers were tested and compared with the published literature. Charts were presented to show that hemoglobin and pH content in urine increase after high altitude flight. It was noted that at a rarefaction of 124 mm Hg, voice becomes very low and coarse, and cough and whistle are impossible. While abdominal pains occur at a relatively low altitude, they are not considered as significant as the pains which occur in the joints and deep tissues at higher altitudes. Data for the present study were derived from high mountain expeditions and experiments in low pressure chambers. M.W.R.

N65-25671 Joint Publications Research Service, Washington, D. C.

THE VALUE OF ELECTROKYMOGRAPHY IN THE DIAGNOSIS OF MITRAL DISEASE COMPLICATED BY FIBRILLATION

M. N. Tumanovskiy, N. M. Shestakov, and V. Ya. Garmash *In its* Soviet Res. on Cardiology 8 Jun. 1965 p 14–19 refs (See N65-25669 15-04) CFSTI: $2.00

Electrokymography is a valuable method for the diagnosis of mitral disease complicated by fibrillation. In case of markedly pronounced stenosis of the left atrioventricular orifice complicated by fibrillation, the left auricular electrokymogram records a straight or undulant line without a periodic pattern. In mild stenosis of the left atrioventricular orifice, the electrokymogram shows a periodic drop of the curve during diastole. Complex mitral disease with equally pronounced stenosis and insufficiency associated with fibrillation cause a small regurgitation notch beginning at the start of the phase of rapid expulsion and sloping decline of the curve during diastole in the electrokymogram of the left auricle. In case of complex mitral disease with prevalence of insufficiency of the mitral valve, associated with fibrillation, the electrokymogram of the left auricle shows a marked regurgitation notch beginning at the end of the phase of isometric tension and marked drop of the curve to the initial line during diastole. N.E.A.

N65-25872# Joint Publications Research Service, Washington, D. C.

NEURAL IMPULSE AND THE CHEMICAL THEORY OF MEMORY

G. Chipen 17 Jun. 1965 14 p Transl. into ENGLISH from Nauka i Tekhn. (Riga), no. 4, Apr. 1965 p 20–23

(JPRS-30676; TT-65-31289) CFSTI: $1.00

Operation of the human brain is discussed in terms of electrochemical activity on the cellular level. The nerve impulse, which is due to electrochemical potential resulting from cellular imbalance of sodium ions, is the brain's source of information about its environment. The flow of nerve impulses across the synaptic gap from one cell to another is analogous to the burning of a fuse, in which the heat of one portion ignites the next. A concept of short- and long-term memory is reviewed in which information in the form of a nerve impulse is retained as changes in the structure of the ribonucleic acid (RNA) molecule; these changes are temporary and become long-term memory only if reinforced by duplicate nerve impulses. J.M.D.

N65-25873# Commerce Dept., Washington, D. C.

CURRENT STATUS AND COMMERCIAL PROSPECTS FOR RADIATION PRESERVATION OF FOOD

Harry W. Ketchum, Jack W. Osburn, Jr., and Jerome Deitch Jan. 1965 183 p refs

(Contract AT(49-11)-2524)

(TID-21431) GPO: $0.55

The following radiation processes were applied to 28 food products: sterilization, pasteurization, disinfestation, disinfection, sprout inhibition, and product improvement. Product evaluations based on the state of technology, industry needs, estimated costs, competitive methods, consumer habits and preferences, and other related information established the following irradiation products as most promising: pasteurized poultry, marine products, and strawberries; sterilized poultry and ham; improved dehydrated vegetables; and disinfected eggs, liquid, frozen, and dried. Also discussed are areas of potential economic impact of food irradiation, and legal and consumer acceptance of irradiated food. G.G.

N65-25876# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITY OF INHIBITING AND STOPPING BLOOD FLOW BY A MAGNETIC FIELD

L. Ye. Belousova 16 Jun. 1965 5 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 10, no. 2, 1965 p 365–366

(JPRS-30635; TT-65-31271) CFSTI: $1.00

The physical aspect of the effect of a magnetic field on blood flow connected with the movement of a fluid having electrical conductivity and viscosity in a transverse magnetic field is examined. Using the Hartmann number M, estimates of the magnetic field which may produce an appreciable reduction in the rate of blood and its stoppage are given. Investigations of the effect of a constant magnetic field on a living organism indicate that the greatest effect of the field is exerted on the vascular system. The absence of morphological changes in the vascular walls of cardiovascular patients subjected to a magnetic field suggest that the magnetic field indirectly affects the vascular system. A qualitative agreement exists between the inhibiting effect of a magnetic field on blood flow, and the movement of an electrical conducting fluid through a rigid tube. N.E.A.

N65-25879# Department of Agriculture, Washington, D. C. Economic Research Service

RADIATION: PASTEURIZING FRESH STRAWBERRIES AND OTHER FRESH FRUITS AND VEGETABLES

Washington, AEC, Mar. 1965 28 p refs

(Contract AT(49-11)-2085)

(TID-21628) CFSTI: $2.00

The economic feasibility of pasteurizing selected produce commodities by ionizing radiation is discussed. A comparison of the preliminary estimates of radiation-pasteurizing costs with estimates of some important benefits which may result from this new method of food preservation is given. A brief discussion of the potential impact of radiation-pasteurizing on produce market structure, conduct, and performance is presented. N.E.A.

N65-25882# Federal Radiation Council, Washington, D. C.
BACKGROUND MATERIAL FOR THE DEVELOPMENT OF RADIATION PROTECTION STANDARDS. PROTECTIVE ACTION GUIDES FOR STRONTIUM-89, STRONTIUM-90, AND CESIUM-137
May 1965 53 p
(Rept.-7) GPO: $0.30

This report provides information and guidance for actions appropriate to situations involving contamination of the environment by the radionuclides strontium-89, strontium-90, and cesium-137. Two conditions of environmental contamination have been examined: an acute localized contaminating event in which prompt action may be necessary to avoid the exposure that would otherwise result; and a widespread, generally increasing, low-level of contamination (from stratospheric fallout) that causes a continuous intake of radioactive materials by large numbers of people for a period of years. Special consideration has been given to the situation in the arctic region where, because of unusual ecological conditions and food chains, some population groups are exposed to levels higher than those in other parts of the United States.
Author

N65-25895# School of Aviation Medicine, Randolph AFB, Tex. Psychology Section
LECTURES IN AEROSPACE MEDICINE. EXPERIMENTAL APPROACHES TO THE PSYCHOPHYSIOLOGICAL PROBLEM OF MANNED SPACE FLIGHT
Bryce O. Hartman [1964] 44 p refs
(AD-612636)

Presented is a description of three major areas of research conducted under the psychophysiological program at the School of Aviation Medicine, which focus on the psychobiological aspects of weightlessness; the maintenance of psychomotor proficiency in the simulated space cabin environment for prolonged periods of time; evaluating gross changes in dynamic behavior in the space cabin resulting from space flight, and evaluating any aberrant behavior which might occur during the flight. Demonstrated are various combinations of physical and environmental stressors which yield an area within which man as a biological specimen survives and functions; and which illustrate the organizing concepts of space scientists, and the role of psychophysiology in the problem of space medicine.
S.C.W.

N65-25924# Army Research Inst. of Environmental Medicine, Natick, Mass.
THE ARCTIC SOLDIER: POSSIBLE RESEARCH SOLUTIONS FOR HIS PROTECTION
Ralph F. Goldman [1962] 23 p refs
(AD-613189)

For protecting the extremities of the inactive man in extremely cold environments, a seven-pound prototype auxiliary heater, with a snap-acting thermostat, was developed. This consists of a 12-volt battery with 11 silver cadmium, 10 amp, rechargeable cells fabricated into a canvas vest. The 120-watt hour system can provide protection up to 8 hr at −40° F with a 3 mph wind; addition of greater watt-hour capacities can offer protection to −65° F with a 10 mph wind and a 2400 windchill. These auxiliary foot and handwarmers can be used with any 12- or 24-volt ac or dc power source, thus eliminating the battery supply and cutting the weight and cost of the present system by over 90%. The new approach could be applied to the development of new torso clothing, since auxiliary heating could reduce overheating during exercise and avoid after-exercise chill.
M.W.R.

N65-25935# Production Group, United Kingdom Atomic Energy Authority, Annon (Scotland)
HEALTH AND SAFETY RESEARCH AT CHAPELCROSS Annual Report 1964
J. H. Martin 1965 8 p refs
(PG-647(CC))

A series of research projects are presented and include biological indicators of radiation exposure, means for removing radionuclides and toxic substances from the body, Solway firth investigations, pond water studies, neutron dosimetry, low level counting, film badge behavior, particulate activity in reactor gas circuits, and studies on noise effects.
R.N.A.

N65-25972*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY STUDY OF THE USE OF A MOMENTUM TRANSDUCER TO MEASURE THE HEART BEAT OF AVIAN EMBRYOS
Vernon L. Rogallo [1965] 17 p
(NASA-TM-X-54041) CFSTI: HC $1.00/MF $0.50 CSCL 6B

A new ultrasensitive momentum transducer has been successfully adapted as a ballistocardiograph to measure the heart beat of avian embryos. Experiments at Ames Research Center have demonstrated that life can be detected as early as 4 days in the incubation period and monitored to maturity without damage to the avian embryo. Changes in heart-beat rate and intensity resulting from temperature changes or other external stimuli were readily detected by the instrument. The technique appears to open new avenues of investigation for application in such areas as vaccine production and drug research.
Author

N65-26034# Joint Publications Research Service, Washington, D. C.
AN EXPERIMENTAL STUDY OF POLYDISPERSE BACTERIAL AEROSOLS. III: A STUDY OF DIPHTHERIA BACILLUS AEROSOLS
V. P. Zhalko-Titarenko 8 Jun. 1965 9 p Transl. into ENGLISH from Zh. Mikrobiol. Epidemiol. i Immunobiol. (Moscow), no. 2, Feb. 1965 p 66–73
(JPRS-30503; TT-65-31214) CFSTI: $1.00

Study of the survival time of diphtheria microbes in an aerosol (starting from the 3rd minute after dispersion and continuing for 120 minutes) revealed that it was dependent on the evaporation of water. In drops with slow evaporation (saliva), it was higher than in rapidly evaporating water particles. The microbes died very rapidly in an aerosol at 35°, but all remained viable at subzero temperatures. The survival time was longer when the large particles in the aerosol were more numerous, but decreased in small-drop fractions.
Author

N65-26065*# Michigan State Univ., East Lansing.
THE EFFECTS OF WEIGHTLESSNESS AND OTHER STRESSES ASSOCIATED WITH FLIGHT IN SPACE ON PATHOGENICITY AND IMMUNITY Final Report
[1964] 25 p
(Grant NsG-514)
(NASA-CR-63282) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Plasmodium berghei infections of mice were studied to determine the feasibility of using this infection for immunity studies and pathogenesis of mice during space flight. Infected mice lost their ability to maintain normal body temperatures

and consumed considerably less oxygen than uninfected animals; pagocytic activity by cells in the liver, spleen, and bone marrow could be demonstrated by radioiron. Treatment of the infection controlled the anemia and increased the erythropoietic activity. It was concluded that this infection experiment could be used on mice in conditions of reduced gravity to observe the effects on the erythropoietic activity. Also presented is the design for a mouse chamber suitable for housing and feeding of five mice for two weeks. G.G.

N65-26128# Joint Publications Research Service, Washington, D. C.

DISCUSSION OF L. A. MILYUTIN'S ARTICLE "A POSSIBLE MECHANISM OF ELECTRICAL ASSYMETRY OF TISSUES"

K. V. Yakimchuk 16 Jun. 1965 5 p refs Transl. into ENGLISH from Biofizika (Moscow), v. X, no. 2, 1965 p 386–387 (JPRS-30634; TT-65-31270) CFSTI: $1.00

The author relates the occurrence of geometrical bio-potentials in animal and plant tissues to the presence of a weak electronic conductivity. The important role of conductors in the development of electromotive forces is demonstrated by the non-uniform diffusion of ions from two drops of electrolyte solution on a moist circular paper, where one of the drops is placed in the center and the other near the rim of the circle. The removal of cations from both drops and the difference in anion concentrations will produce an electrical potential of 80 to 90 millivolts. G.G.

N65-26129# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE. PHASE V: THE MUSCULOSKELETAL ANATOMY OF THE ANTEBRACHIUM OF AN ADULT FEMALE CHIMPANZEE

William E. Edwards Apr. 1965 48 p refs
(ARL-TR-65-4; AD-462434)

The left antebrachial musculature of a young-adult female chimpanzee is described and illustrated with the accuracy of detail plus clarity made possible by the photo-etching process. Other data are depicted graphically by section drawings. Comparisons with data from the literature on other chimpanzees, apes, humans, and non-hominoid primates are also provided, with emphasis on quantitative aspects. Author

N65-26142# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INFLUENCE OF CERTAIN PHARMACOLOGICAL PREPARATIONS ON THE BIOELECTRIC ACTIVITY OF THE BRAIN IN SCHIZOPHRENIA

A. L. Gamburg and A. M. Denisova 20 Apr. 1965 18 p refs Transl. into ENGLISH from Zh. Nevropatol. i Psikhiatr. (Moscow), v. 64, no. 1, 1964 p 116–124
(FTD-TT-65-388/1+2; AD-614403)

Utilizing 51 schizophrenic patients and 9 normal subjects, studies were conducted on modifications of the bioelectric activity of the brain in the course of pharmacological tests. By means of EEG indications, some troubles of basic activity were proved with certain patients, and also the character of response to doses of extraordinary excitants. Modifications of biopotentials after the injection of adrenalin, acetylcholine or atropine into the patients were very different than those observed with the normal subjects. At the same time, adrenalin and atropine as well as corticotropine, cortisone, desoicortisone or thyreoidine, eliminate in a selective manner, certain pathological elements of the EEG in certain forms of schizophrenia. Acetylcholine caused evident pathological modifications in the EEG. One such effect of the medications used has been partially explained by their influence on the adrenergic and cholinergic systems. The results of the research, according to the authors, can facilitate the analysis of pathogenic mechanisms and the research for means of normalization of the reaction of cerebral structures in schizophrenia. Author

N65-26221# Joint Publications Research Service, Washington, D. C.

CYBERNETICS IN MOLECULAR BIOLOGY AND IN THE THEORY OF PERCEPTION

9 Jun. 1965 36 p refs Transl. into ENGLISH from Deut. Z. für Philosophie (Berlin), no. 3, 1965
(JPRS-30523; TT-65-31221) CFSTI: $2.00

CONTENTS:

1. CYBERNETICS IN MOLECULAR BIOLOGY K. Fuchs-Kittowski p 1–28 refs (See N65-26222 15-04)

2. ON THE SIGNIFICANCE OF THE THEORY OF PERCEPTION IN NEUROCYBERNETICS G. Klaus p 29–33 refs (See N65-26223 15-04)

N65-26222 Joint Publications Research Service, Washington, D. C.

CYBERNETICS IN MOLECULAR BIOLOGY

Klaus Fuchs-Kittowski *In its* Cybernetics in Mol. Biol. and in the Theory of Perception 9 Jun. 1965 p 1–28 refs (See N65-26221 15-04) CFSTI: $2.00

The discussion presented is based essentially on an inquiry into three problems: 1. The significance of systems of regulation of cellular metabolism in regard to the adaptability of the individual cell; 2. A series of viewpoints in the discussion on the dialectic-materialistic concept of determinism in biology; 3. The dialectic relation of automaton and life and in connection with this, the dialectic relation of preformation and epigenesis. Author

N65-26223 Joint Publications Research Service, Washington, D. C.

ON THE SIGNIFICANCE OF THE THEORY OF PERCEPTION IN NEUROCYBERNETICS

George Klaus *In its* Cybernetics in Mol. Biol. and in the Theory of Perception 9 Jun. 1965 p 29–33 refs (See N65-26221 15-04) CFSTI: $2.00

A discussion on neurocybernetics concludes that this new discipline within the science of cybernetics is applicable to medicine, education, and psychology, and the theory of perception. It suggests that the proposed hypothesis of three stages which regulate and control the organism could change present concepts of human perception. This hypothesis holds that nonconditioned and conditioned reflexes are elementary algorithms constituted by stimuli and responses; and that these algorithms are replaced by chains and, eventually, nets of algorithms. In addition to this system, referred to as the algorithms of behavior, a system of meta-algorithms, concerned with the formation of the first, is evolved. This second set is superposed by a third set of meta-meta-algorithms. It is suggested that the three systems present an analogy to logic. Further discussion concludes that modern medicine requires a radical change in the formation of theory and in general methodology rather than more extensive factual materials and new experimentation. M.W.R.

N65-26228# Library of Congress, Washington, D. C. Aerospace Technology Div.

A.T.D. PRESS SPECIAL EXPRESS ISSUE, VOLUME 3, NO. 243

14 Jun. 1965 20 p refs Abstracts of two Soviet Articles on Manned Space Flight

CONTENTS:

1. SPACE-ORIENTED ECOPHYSIOLOGY IN THE USSR p 1–8 refs (See N65-26229 15-04)

2. PHYSIOLOGICAL EFFECTS OF GRAVITATION p 9–17 refs (See N65-26230 15-04)

N65-26229 Library of Congress, Washington, D. C. Aerospace Technology Div.

SPACE-ORIENTED ECOPHYSIOLOGY IN THE USSR

In its A.T.D. Press Special Express Issue, Vol. 3, No. 243 14 Jun. 1965 p 1–8 refs (See N65-26228 15-04)

Ecophysiology is defined as a group of biological disciplines concerned with the vital activity and behavior of living organisms exposed to space conditions, or to space flight on rocket-propelled vehicles. Environmental conditions under study in the Soviet Union include vacuum research, cosmic and solar irradiations, effects of low temperatures, effects of acceleration, problems of weightlessness, creation of artificial atmospheres, closed ecological systems, and training and adaptation of astronauts. G.G.

N65-26230 Library of Congress, Washington, D. C. Aerospace Technology Div.

PHYSIOLOGICAL EFFECTS OF GRAVITATION

In its A.T.D. Press Special Express Issue, Vol. 3, No. 243 14 Jun. 1965 p 9–17 refs (See N65-26228 15-04)

By weightlessness induced physiological changes in the spheres of: (1) afferentation and analyzer activities, (2) motor coordination, and (3) vegetative regulation of the body functions are briefly reviewed with emphasis on data and observations from Soviet cosmonaut space flights. It was concluded that weightlessness does not spontaneously affect the physiological processes but acts through a number of adaptive, compensatory, disruptive, and inhibitory processes on the organism. Changes in receptor function and afferentation lead to illusions characterized by disorientation and spatial analysis, to inhibition of internal organ functions, disruption of the vestibular-vegetative system, discoordination of movements, and lowered work capacity. G.G.

N65-26240# School of Aerospace Medicine, Brooks AFB, Tex.

THE EFFECT OF TOTAL-BODY IRRADIATION ON DNA SYNTHESIS IN RAT SPLEEN AND BONE MARROW IN VITRO Final Report

Harold L. Kundel and Donald F. Logsdon, Jr. Mar. 1965 10 p refs

(SAM-TR-65-14; AD-462953)

During the first two hours after total-body irradiation a rapid depression of DNA synthesis in rat spleen and bone marrow was found. An in vitro assay system for DNA synthesis was used. A two-component dose-response curve was found suggesting the possibility that there are two different sites of radiation damage to DNA synthesis. Author

N65-26241# School of Aerospace Medicine, Brooks AFB, Tex.

NEUTRON-INDUCED DENTAL FRAGILITY

Donald G. Willhoit, William K. Collett, and Niel Wald Mar. 1965 12p refs

(SAM-TR-65-8; AD-462985)

After whole-body fission neutron irradiation of Sprague-Dawley rats, a high incidence of dental defects was observed at neutron doses significantly lower than those previously reported in the literature. A recurrence of the defects in subsequent developmental cycles was also noted. Disturbance of enamel formation was seen in animals exposed to 80 rads. Interference with dentin formation resulting in osteodentin and dentinal niches in the labial aspect of the incisors was observed after 125 and 170 rads. This gross macroscopic change was verified in histologic sections and radiographs. The fact that some teeth exhibiting these gross structural defects have fractured a second time supports the possibility that some degree of permanent damage is inflicted on the developing tooth germ. The fact that the niche is observed only in the incisor dentin of the labial side, as has been observed in x-ray studies, indicates that neutrons affect the teeth in a similar manner to x-rays, although neutrons seem to be four times more effective than x-rays in producing these dental defects. Author

N65-26242# School of Aerospace Medicine, Brooks AFB, Tex.

CARBON DIOXIDE, OXYGEN, AND ACIDITY: THE INTERACTION AND INDEPENDENT EFFECTS ON BREATHING OF THESE FACTORS IN THE ARTERIAL BLOOD

Robert William Hamilton, Jr. and E. B. Brown, Jr. Dec. 1964 48 p refs

(SAM-TR-64-94; AD-462984)

Experiments were conducted on pentobarbital anesthetized dogs and on trained unanesthetized dogs to determine the independence or degree of interaction among the three chemical stimuli: O_2, CO_2 and H^+ (measured in arterial blood) as respiratory stimulants. The interaction of the CO_2–H^+ complex and low oxygen, as described by others, was reconfirmed. Further dissection of this relationship indicated that the interaction is between CO_2 and O_2 and the H^+ is not involved. The interaction of CO_2 and H^+ was determined with oxygen tension held above 200 mm. Hg, at which level it is unimportant as a respiratory stimulant. It appears that the response to CO_2 decreases as the level of H^+ increases and vice versa. We interpret this as a negative interaction between these two chemical agents. Author

N65-26243# Texas A&M Research Foundation, College Station.

AMINO ACID ANALYSES OF LENSES AND VITREOUS, AND ENZYMATIC CHANGES FOLLOWING EXPOSURE TO CATARACTOGENIC AGENTS

T. M. Ferguson, J. R. Couch, and E. B. Dawson Brooks AFB, Texas, School of Aerospace Med., Oct. 1964 21 p refs

(Contract AF 41(657)-293)

(SAM-TDR-64-19; AD-457588)

The complete compilation of data from the biochemical studies of effects of various cataractogenic methods is presented. The methods include x-ray, dinitro-phenol, and dietary avitaminosis E. The amino acid concentrations in the lenses of treated turkeys and controls are presented, showing the susceptibilities at differing ages. The effects of avitaminosis E on certain turkey lens enzyme systems are also presented. Author

N65-26295# Brookhaven National Lab., Upton, N. Y.

MEDICAL SURVEY OF THE PEOPLE OF RONGELAP AND UTIRIK ISLANDS NINE AND TEN YEARS AFTER EXPOSURE TO FALLOUT RADIATION (MARCH 1963 AND MARCH 1964)

Robert A. Conard et al May 1965 171 p refs

(BNL-908(T-371)) CFSTI: $5.00

The results of a follow-up medical survey conducted 9 to 10 years after exposure to radiation fallout are presented. Initial examinations showed low levels of leukocytes and platelets of the peripheral blood in the 64 people who received 175 rads; this condition was less marked in the groups receiving less exposure. Annual hematological follow-up studies have revealed that the levels of white cells and platelets of the peripheral blood in the exposed group never reached the levels of the unexposed comparison population. Beta burns of the skin and epilation appeared about 2 weeks after exposure, mainly on parts of the body not covered by clothing. During the past several years, increased numbers of pigmented nevus-like lesions were noted in previously irradiated areas of the skin but appeared to be benign. Comparative radiochemical analyses of urine samples of the exposed and

unexposed population are tabulated. A full-term still birth with congenital anomalies was born to exposed parents in 1962. A case of congenital heart defect was noted in a child born to exposed parents several years ago. Except for one ectopic pregnancy, no miscarriages were reported during this two year period. Statistics on mean blood counts, hematological findings, anthropometric studies, serum folic acid levels, and bone marrow differential counts are also included. R.W.H.

N65-26318# Mississippi State Univ., State College. Dept. of Microbiology

PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL EVALUATION OF ELECTROCHEMICAL DEGRADATION OF HUMAN WASTES

Robert G. Tischer, Lewis R. Brown, and Maurice V. Kennedy Oct. 1964 75 p refs

(Contract AF 41(609)-1633)

(AD-461006)

A clear solution of salts and cellulose resulted from electrolysis of one man's daily output (100 g feces; 1500 g urine) using platinum electrodes. Only 5.76 K.W.H. were required. Substantial reductions were noted in chemical oxygen demand (75%), total solids (37%), suspended solids (56%) and Kjeldahl nitrogen (82%). Oxygen (225 l), hydrogen (486 l), carbon dioxide (56 l), nitrogen (22 l), and chlorine (none) were evolved. Several facets of the electrochemical process were elucidated, including attempts to balance chemically the elements carbon, nitrogen, chlorine, phosphorous, and sulfur. Electrolyzed daily output (EDO) employed to grow *Chlorella* 71105 (after 1:5 dilution with distilled water) yield maximum growth (3.058 g/l dry weight) 50% greater than Knop's control. A simple, miniature prototype model designed to serve as the starting point for a full scale prototype for in-space-flight testing has been described. The rate of gas production is employed to evaluate performance efficiency. Author

N65-26378# Atomic Energy Commission, Washington, D. C. Div. of Technical Information

RADIOBIOLOGY

A. M. Kuzin, ed. Oak Ridge, Tenn., AEC, 1964 253 p refs Transl. into ENGLISH of Radiobiologiya (Moscow), v. 4, no. 1, 1964

(AEC-TR-6404) CFSTI: $6.00

CONTENTS:

1. EFFECTS OF IONIZING RADIATION ON THE SYSTEM OF HYDROGEN BONDS OF DNA MACROMOLECULES P. I. Tseitlin, G. P. Yaskevich, and N. I. Ryabchenko p 1–10 refs (See N65-26379 15-04)

2. SPECTROPHOTOMETRIC EVALUATION OF RADIATION DAMAGE OF HEMOGLOBIN K. I. Pravdina p 11–22 refs (See N65-26380 15-04)

3. SOME PROBLEMS OF THE THEORY OF THE BIOLOGICAL ACTION OF FAST NEUTRONS A. M. Kuzin p 23–29 refs (See N65-26381 15-04)

4. INFLUENCE OF IONIZING RADIATION ON THE SUBMICROSCOPIC STRUCTURES OF THE STRIATED MUSCLES M. M. Gol'dshtein p 30–38 refs (See N65-26382 15-04)

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N65-26379 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

EFFECTS OF IONIZING RADIATION ON THE SYSTEM OF HYDROGEN BONDS OF DNA MACROMOLECULES

P. I. Tseitlin, G. P. Yaskevich, and N. I. Ryabchenko *In its* Radiobiology 1964 p 1–10 refs (See N65-26378 15-04) CFSTI: $6.00

The action of X-rays on the melting curves of DNA was investigated to determine the effects of ionizing radiation on the systems of hydrogen bonds in the macromolecule. Doses of X-ray irradiation, that do not influence the value of the proton energy at a wavelength of 260 millimicrons of DNA solutions at room temperature, lead to an appreciable reduction of the melting point, and to a deterioration of the melting contour when irradiation dosage is increased. The reduction of the melting point displacement of the hydrogen bonds (T_m) is linearly related to the irradiation dose. It is hypothesized that the reduction of T_m and deterioration of the melting contour result from the presence of single cleavages in DNA, which separate the single ordered system of hydrogen bonds into a number of independent double-helical portions. The melting of these portions occurs at lower temperatures as a result of their lower molecular weight (about 100 000 and below). L.S.

N65-26380 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

SPECTROPHOTOMETRIC EVALUATION OF RADIATION DAMAGE OF HEMOGLOBIN

K. I. Pravdina *In its* Radiobiology 1964 p 11–22 refs (See N65-26378 15-04) CFSTI: $6.00

Aqueous solutions of hemoglobin in concentrations of 8–160 mg% were irradiated, and radiation damage was spectrophotometrically determined according to the increase in the extinction coefficient $K_t(500/540)$] and according to the decrease in the absorption at 578 millimicrons. At 630 millimicrons, the absorption increases markedly upon irradiation. Great sensitivity to alkaline denaturation of irradiated hemoglobin, and the presence of an oxygen effect and an oxygen aftereffect was detected. Rat and pigeon blood was used in the experiment, and it was found that pigeon hemoglobin is more radiosensitive than rat hemoglobin. L.S.

N65-26381 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

SOME PROBLEMS OF THE THEORY OF THE BIOLOGICAL ACTION OF FAST NEUTRONS

A. M. Kuzin *In its* Radiobiology 1964 p 23–29 refs (See N65-26378 15-04) CFSTI: $6.00

Data on the relative biological effectiveness (RBE) of neutron irradiation, compiled from the literature, were tabulated. An analysis indicates that when large doses which produce a rapidly appearing effect are used, the RBE of neutrons proves to be either equal to or greater than one. This seems true for the death of animals in acute experiments, for the appearance of mutations, and for long term destructive processes. Conclusions drawn from the data indicate that the significant increase in the RBE in the case of chronic influence of small doses of neutrons (and for long-term aftereffects) should be specially considered in organizing radiobiological protection for chronic irradiation conditions. The theory of the appearance of a large number of irreparable damages under the influence of neutrons was not confirmed. In the case of prolonged chronic irradiations, the increase in the RBE is believed due to the different character of the accumulation of damage in gamma and neutron irradiation. The data are also discussed in relation to the structural metabolic theory. L.S.

N65-26382 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

INFLUENCE OF IONIZING RADIATION ON THE SUBMICROSCOPIC STRUCTURES OF THE STRIATED MUSCLES

M. M. Gol'dshtein *In its* Radiobiology 1964 p 30–38 refs (See N65-26378 15-04) CFSTI: $6.00

Electrical parameters of the gastrocnemius muscle of the frog *R. temporaria* were measured before and after irradiation in order to study the changes in the submicroscopic structure. Tests on the dynamics of the muscle swelling in distilled water, and on the optical density (O.D.) of the muscles in transmitted light were also run, so that the development of radiation damage in the tissue could be determined by comparing the results with time. Results indicate that directly after an irradiation dose of 134.4 krad, the ohmic component of the impedance of the muscles at low frequencies of 1 to 100 kc/sec decreases, and that this decrease progresses with time. The ohmic component at the high frequency of 1 Mc/sec remained unchanged. The capacitive component begins to differ from the control after 20 minutes, but does not drop sharply until 2.5 hrs after irradiation. The swelling rate of the muscles in distilled water increases substantially 20 minutes after irradiation, and the optical density changes in two phases. First the O.D. decreases, but then increases with the greatest rate of O.D. growth beginning three hours after irradiation. L.S.

N65-26383 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

DEPENDENCE OF THE RADIOSENSITIZING EFFECT OF OXYGEN ON ITS CONCENTRATION AND THE LIFETIME OF FREE RADICALS

V. P. Paribok *In its* Radiobiology 1964 p 81–84 refs (See N65-26378 15-04) CFSTI: $6.00

An explanation is proposed for the dependency of the radiosensitizing action of oxygen on its concentration. In the radiation of a living cell containing a large amount of water, the short-lived free radicals that arise react with oxygen molecules only if they collide. The probability of the collision is dependent upon the lifetime of the radical, and the waiting time between two successive collisions of oxygen molecules with the same point of the radiosensitive biomolecule. If the oxygen concentration increases, the waiting time decreases. If at some oxygen concentration the waiting time is equal to the lifetime of the radical, then a further reduction of the waiting time does not influence the result of the reaction since it has already reached a maximum; but if the waiting time is increased, the reaction yield will decrease. The waiting time can be calculated if the number of collisions of oxygen molecules with a unit surface in a unit time is known; formulas for these calculations are given. L.S.

N65-26384 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

STUDY OF THE "OXYGEN EFFECT" AT VARIOUS RADIATION DOSE RATES

I. B. Bychkovskaya and G. K. Ochinskaya *In its* Radiobiology 1964 p 85–90 refs (See N65-26378 15-04) CFSTI: $6.00

Beetles *Calandra granaria* (granary weevil) were irradiated in mediums containing oxygen concentrations from 0% to 21%, for studying the oxygen effect at various radiation dose rates. The criteria of radiation action were survival of the beetles, and their average lifetimes. Results indicate that the dependency of radiation injury of weevils on the oxygen concentration in the medium at the moment of irradiation is characterized by an S-shaped curve with a sharp increase in injury at a definite oxygen concentration, and then a leveling off to an oxygen ceiling. Further increase in the oxygen concentration does not affect the radiation effect. Within a definite range of oxygen concentrations, the radiation injury of the beetles is dependent on very small changes in the oxygen concentration in the medium, and does not depend on changes in the dose rate. L.S.

N65-26385 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

TIME–EFFECT CURVES FOR THE IRRADIATION OF DORMANT SEEDS WITH VARIOUS MOISTURE CONTENTS

N. A. Poryadkova *In its* Radiobiology 1964 p 91–97 refs (See N65-26378 15-04) CFSTI: $6.00

Dormant seeds of peas with moisture contents of 9% and 18% were irradiated to determine whether the moisture content influences the amount of primary injuries or the development of the radiation injury with time. A comparison of the time–effect curves indicates that the initial stage of injury in both is the same, but that the decrease in the number of damaged cells occurs more rapidly in seeds with 18% moisture content. This appears to confirm that the moisture content of dormant seeds does not influence the number of potential cytogenetic damages that arise during irradiation, but exerts a vital influence on the recovery of the cells from these injuries. L.S.

N65-26386 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

THE MODEL OF "REMOVAL OF THE EFFECTIVE DOSE" AND REACTIVATION OF CELLS IRRADIATED BY ULTRAVIOLET

E. N. Kabakov *In its* Radiobiology 1964 p 103–111 refs (See N65-26378 15-04) CFSTI: $6.00

The assumption that photoreactivation of cells subject to uv irradiation represents a gradual removal of the absorbed uv dose is analyzed to determine the validity of a mathematical model for the dynamics of photoreactivation phenomena. A comparative analysis of the ratio of forms of inactivation in uv irradiation of a yeast population and its post-radiation recovery, indicate that photoreactivation can be described in terms of removal of the effective dose. In the case of dark recovery, the model is formally applicable, but does not reflect the essence of the process. L.S.

N65-26387 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

ON THE PERIODS OF REALIZATION OF POTENTIAL RADIATION INJURIES IN DIPLOID YEAST CELLS

V. I. Korogodin *In its* Radiobiology 1964 p 112–125 refs (See N65-26378 15-04) CFSTI: $6.00

Diploid yeasts were irradiated, placed under conditions favorable for budding, and were then transferred to a nonnutritive medium after various periods of time. The fraction of budding individuals and the fraction of cells capable of recovery were determined, and the two indices were compared for potential radiation injuries in the yeast cells. Comparison of the results with similar experiments on plants and paramecia indicate that the realization of potential radiation injuries, responsible for the death of irradiated yeast cells after one or several cycles of multiplication, occurs during the same period of the life cycle of the irradiated individual as in the case of the realization of potential injuries producing chromosomal aberrations in plant cells, or recessive lethal mutations in the micronuclei of paramecia. It is suggested that the mechanism of such realization is identical in all three cases. L.S.

N65-26388 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

RADIOSENSITIVITY OF THE UNICELLULAR ALGA *CHLORELLA VULGARIS*

I. A. Zakharov and V. V. Tugarinov *In its* Radiobiology 1964 p 126–130 refs (See N65-26378 15-04) CFSTI: $6.00

A suspension of unicellular alga *Chlorella vulgaris* culture in water, was irradiated, and its radiosensitivity to various X-ray doses was studied. A multi-hit inactivation curve was obtained for cell survival vs dose. It was found that the semilethal dose for *Chlorella* cells is 14.5 kr. From 16 kr to 64 kr, the frequency of pigmented mutations increases with increasing dosage and has an approximately linear dependence. L.S.

N65-26389 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

EVALUATION OF THE REPARATION OF RADIATION INJURIES ACCORDING TO AN INVESTIGATION OF THE STATE OF MYELOPOIESIS OF DOGS UNDER REPEATED ACTIONS OF IONIZING RADIATION

V. A. Rezontov *In its* Radiobiology 1964 p 149–156 refs (See N65-26378 15-04) CFSTI: $6.00

Myelopoiesis in dogs at various periods of recovery from radiation sickness was analyzed for evaluating the reparation of radiation injuries. The reaction of the blood system of the animals to the repeated influence of gamma radiation was also studied. The intensity of reparative regeneration of the hematogenic tissue was evaluated indirectly by measuring the rate of restoration of the leukocyte content in the peripheral blood of the dogs. Results indicate that during 1.5 months to 15 months after irradiation with doses of 300 rad, a decrease in the intensity of reparative regeneration of the hematogenic tissue is detected. The magnitude of this reduction of reparation potency of myelopoiesis did not depend on the degree of normalization of the cytological composition of the peripheral blood and bone marrow at the time of the repeated test irradiation. The decrease in the indicated residual effect with respect to time can be reduced to an exponential or logarithmic mathematical model. Extrapolation of the established dependence to the moment of natural death of the dogs leads to the assumption that the reparation potency of myelopoiesis can be restored by the end of the life to no more than 90% of the initial value after irradiation. L.S.

N65-26390 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

INFLUENCE OF RADIOPROTECTIVE PREPARATIONS ON THE DISTRIBUTION OF NEUTRAL RED AND THE HEMOGLOBIN CONTENT IN THE ORGANS OF MICE AND RATS

P. G. Zherebchenko, G. M. Airapetyan, I. G. Krasnykh, and A. N. Shevchenko *In its* Radiobiology 1964 p 190–200 refs (See N65-26378 15-04) CFSTI: $6.00

Blood circulation in organs of mice and rats was traced to study the influence of various radioprotective drug preparations on the distribution of neutral red and hemoglobin content in the organs. Tables listing preparations, dosages, organs analyzed, survival data, hemoglobin content, and neutral red content support the experimental data. Among the drugs tested were tryptamine compounds, cystamine, acetylcholine, histamine, and unithiol, and their effect on the brain, liver, lungs, spleen, kidneys, skin, and muscles is discussed. L.S.

N65-26391# Joint Publications Research Service, Washington, D. C.

ROENTGENOLOGY AND RADIOLOGY IN INDUSTRY AND MEDICINE

15 Jun. 1965 47 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 10, no. 4, 1965

(JPRS-30622; TT-65-31265) CFSTI: $2.00

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N65-26392 Joint Publications Research Service, Washington, D. C.

CALCULATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF BETA-RADIOACTIVE GASES IN AIR OF WORK PREMISES AND IN THE ATMOSPHERE

G. M. Obaturov *In its* Roentgenol. and Radiol. in Ind. and Med., 15 Jun. 1965 p 1–12 (See N65-26391 15-04) CFSTI: $2.00

Presented are calculations of maximum permissible concentrations (MPC) of isotopes of radioactive gases in the air, which consider the effect of the following factors on the calculated MPC value: (1) internal radiation due to inhaled radioactive gas and gas dissolved in the human blood; (2) internal irradiation from radioactive daughter products of decay of the short-lived noble gases xenon and crypton; (3) restrictions in the space of work quarters ($R \neq \infty$, where R = effective radius of quarters); (4) radiobiological sensitivity of the human organs; and (5) absorption of β-particles in the dead layer of skin upon irradiation of the latter, in the skin upon irradiation of muscle and fat tissue, and in the cornea and frontal chamber upon irradiation of the eye lens. Comparative MPC data are included for work premises, sanitary-protective zones, and the populace. S.C.W.

N65-26393 Joint Publications Research Service, Washington, D. C.

DISTRIBUTION AND BIOLOGICAL ACTION OF RADIOACTIVE ISOTOPES

Ya. I. Moskalev *In its* Roentgenol. and Radiol. in Ind. and Med., 15 Jun. 1965 p 13–20 refs (See N65-26391 15-04) CFSTI: $2.00

An analysis of the distribution, kinetics of accumulation, and modes of excretion of radioactive isosotopes in various organs (liver, spleen, etc.) of living organisms, is presented. Included is a discussion of differences in the distribution patterns of several groups of elements, factors which alter the type of distribution of certain elements, criteria to be considered when estimating the toxicity of a given isotope, and the effectiveness of α-, β-, and γ-1 radiators in the organism. Considered in the analysis are the effects of differences in distribution of radioactive elements, and the effective period of half-excretion of the radiation source, on the pathogenesis of radiation sickness. S.C.W.

N65-26394 Joint Publications Research Service, Washington, D. C.

THE CONDITION OF WALLS OF LARGE BLOOD VESSELS IN ACUTE RADIATION SICKNESS

K. B. Tikhonov and I. A. Chalisov *In its* Roentgenol. and Radiol. in Ind. and Med., 15 Jun. 1965 p 21–27 refs (See N65-26391 15-04) CFSTI: $2.00

A comparative study of functional and morphological changes in large and small blood vessels, which occur during radiation exposure and radiation sickness is reported with emphasis on the causes and extent of injury to large vessels. Presented also are results of experimental studies on dogs and rabbits, which were subjected to whole-body, massive, and local irradiation, and which subsequently developed acute radiation sickness. No distinct symptoms of pathological changes were detected in large blood vessels during acute radiation sickness. Although severe contraction of these vessels occurred during the peak period of acute radiation sickness, it was concluded that these changes were functional and due to contraction of circular muscle fibers of the median arterial membrane. Organic changes, such as destruction and lesions of the walls, and hemorrhage were common only to small vessels. After massive irradiation, small vessels being the most physiologically active were more severely damaged; trunk vessels did not show appreciable structural alterations. Greatest damage was observed after exposure to local irradiation, which resulted in injuries so profound that total breakdown of the vascular walls occurred. Speculation is made concerning the significance of these findings in future research. S.C.W.

N65-26396 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL DATA ON THE ACTION OF IONIZING RADIATION ON THE BONES OF GROWING ANIMALS

V. V. Kholin *In its* Roentgenol. and Radiol. in Ind. and Med., 15 Jun. 1965 p 31–39 refs (See N65-26391 15-04) CFSTI: $2.00

A review of experimental studies reported in the literature, which focus on the influence of ionizing radiation and age on the extent of bone radiosensitivity in growing animals is presented. Also considered were studies on morphological and functional changes occurring after local irradiation, whole-body irradiation of large zones of the trunk, radiation resulting from the internal administration of radioactive agents; and changes occurring during acute radiation sickness. It is surmised that the pathogenesis of osteogenetic disturbances during radiation sickness are more complex than injuries occurring during local irradiation, since characteristic changes occur on all levels of the osteal system. In addition to the direct action of radiation on bone tissue, the mediated negative effect resulting from damage to several other systems plays an important role. Thus, osteogenic changes can occur during the presence or absence of radiation sickness. It is further noted that there exist no fundamental morphological osteogenic differences during radiation sickness or local irradiation injury. Thus, with decrease in age, the extent of radiation injury increases. S.C.W.

N65-26409*# Naval School of Aviation Medicine, Pensacola, Fla.

SOME RELATIONSHIPS BETWEEN BLOOD ALCOHOL, POSITIONAL ALCOHOL NYSTAGMUS (PAN), AND POSTURAL EQUILIBRIUM (ATAXIA)

Alfred R. Fregly, Martin Bergstedt, and Ashton Graybiel 17 Mar. 1965 19 p refs Joint Report with NASA
(NASA Order R-93)
(NASA-CR-63423; NSAM-917) CFSTI: HC $1.00/MF $0.50 CSCL 06T

Quantitative relationships were explored between blood alcohol levels, positional alcohol nystagmus (PAN), and postural equilibrium performances measured with a new quantitative ataxia test battery and with a series of clinical-type ataxia tests. Moderate amounts of 80-proof vodka (1 cc per lb. body wt.; 55–100 mg% blood alcohol level) produced appreciable decrements in the postural equilibrium functioning of all thirteen vestibular normal subjects evaluated. Maximum decrements occurred at 60–75 minutes following alcohol intake and were fairly well correlated with the peak blood alcohol levels. But more strikingly, the ataxic responses were in very close agreement with the intensity and duration of the PAN 1 (intoxication period) responses along the time axis. No systematic relationships between the ataxia test performances and PAN phase II responses were found. Ataxic performances recovered during the PAN II period. Repetition of the experiment two days later with the same subjects under increased stimulation (100-proof vodka in the same dosage) reproduced the findings generally proportional to the increased stimulus. Author

N65-26418*# Northrop Space Labs., Hawthorne, Calif. Space Labs.
FEASIBILITY STUDY OF INTEGRAL HEAT SINK SPACE SUIT CONCEPTS
A. P. Shlosinger and W. Woo May 1965 28 p refs
(Contract NAS2-2102)
(NASA-CR-63399; NSL-65-87-2) CFSTI: HC $2.00/MF $0.50 CSCL 06Q

This report presents the results of an analytical study to determine feasibility and identify problem areas of a space suit thermal control concept, relying on phase change of heat sink materials, distributed over the suit area, for control of sensible metabolic heat. The performance of materials with melting points below the desirable skin temperature of man with heats of fusion near or above 50 kilocalories/kg (100 BTU/lb) has been evaluated. The formation of a layer of molten heat sink material of low thermal conductivity has been identified as the major factor in limiting suit performance. Several concepts to improve suit performance are presented and evaluated as to their merit for further development work. Feasibility of the basic concept for stated limited operating time periods, and feasibility of the improved concepts has been demonstrated. Author

N65-26531 Library of Congress, Washington, D. C. Aerospace Technology Div.
OTHER FORMS OF IMAGES. THE RETINAL IMAGE AND ITS TRANSFORMATION WITHIN THE VISUAL SYSTEM
A. V. Luizov *In its* Quality of the Phot. Image 11 Mar. 1965 p 218–227 refs (See N65-26508 15-14)

An analysis of the factors contributing to the transformation of images and the transmission of information within the visual system, which focuses on the role of the retina and its component parts in the visual perception of objects at the moment of their projection into the visual field, is presented. Included is a comparative study of existing theories on the function of signals associated with brilliance variation, the existence of light sensitive substances within the cones, the flexibility and/or stability of the visual system, and the question of image reversal in the eye. Proposed is a formula which connects visual acuity with the contrast of an object against a background and with background brilliance. Speculation is made concerning the importance of related research on the visual system to the development of improved optical devices as telescopes, microscopes, and television screens. S.C.W.

N65-26585# California U., Berkeley. Operations Research Center
GROUP-TESTING WITH UNCERTAIN TEST RESULTS
R. M. Elashoff, Milton Sobel, and Marvin Schneiderman Jan. 1965 15 p
(Grant PHS-GM-9606-04)
(ORC-65-4)

Three models were proposed in order to classify a random sample of known units into good (or negative), and defective (or positive) categories. The models were discussed in the framework of testing the activity of experimental drugs and the detection of disease. Model I, *Lack of Specificity Problem*, allowed only false positives, and Model II, *Dilution Problem*, permitted only false negatives. Model III, *Both Errors Possible*, allowed for both positives and negatives. Variations of the models are also considered, and formulas are included. An effort is made to minimize the expected number of tests for the procedure, and it is assumed that the tests are carried out one at a time in a linearly-ordered manner. M.W.R.

N65-26596# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information
INDUSTRIAL HEALTH IN HANDLING THORIUM
N. Yu. Tarasenko May 1965 84 p refs Transl. into ENGLISH from the publ. "Gigiena Truda pri Rabote s Toriem" Moscow, Gosatomizdat, 1963
(AEC-TR-6536(Rev.)) CFSTI: $3.00

An evaluation of the working conditions and prophylactic measures in the handling of thorium is given, after the principal physical and chemical properties of this element which are of interest to medical workers are outlined. The differing behavior of thorium in the organism depends on the state of its compounds and the presence of admixtures of daughter products of decay, as well as by the method of its administration. The generally poor absorbability; deposition of thorium in the osseous tissue, lungs, and reticuloendothelial system; and the prolonged retention of thorium in the sites of administration and deposition enhance the radiation effect of thorium since it acts as α-emitter with subsequent decay products. The hygenic and health aspects of working conditions involving thorium processes are analyzed, and detailed protection measures to insure safe working conditions are presented. G.G.

N65-26617# School of Aerospace Medicine, Brooks AFB, Tex.
THE ADAPTATION OF GAS CHROMATOGRAPHY TO THE PROBLEM OF PHYSIOLOGIC GAS ANALYSIS AT HIGH ALTITUDE Technical Documentary Report, 14 Feb.–8 Jul. 1964
Harold R. Andersen Apr. 1965 13 p refs
(SAM-TR-65-2; AD-464379)

A method which permits the analysis of mixtures of O_2, N_2, and CO_2 at high altitude is described. A commercial model gas chromatograph was modified to permit the introduction of the gas samples into the chromatograph at the altitude at which they were collected. The advantages of this procedure are: (a) minimal exposure of the investigator to high altitude, and (b) elimination of sample contamination which might result from descent to lower altitudes. Author

N65-26618# School of Aerospace Medicine, Brooks AFB, Tex.
LABORATORY PERFORMANCE OF AN AGING 20% STANNOUS FLUORIDE SOLUTION (CODE SAM X-14)
Ira L. Shannon Mar. 1965 10 p refs
(SAM-TR-65-15; AD-464184)

Determination of spatial distribution of barium ion densities and electron temperatures in a fully ionized barium plasma is described. The ion densities are deduced from measurement

of resonance fluorescence of the barium ion excited by an external light source. The space resolution is provided by the volume of the overlap of the exciting beam and the field of view of the measuring monochromator. The exciting beam is modulated, and the detector includes a phase-sensitive lockin amplifier. The electron temperature is deduced from the rate of electronic excitation and the measured plasma brightness without the externally induced fluorescence. It is only obtained as an average along the line of sight of the monochromator. Comparison of the measurements of the two resonance lines allows the conclusion that the effective threshold Gaunt factor for excitation of the 6^2P states of Ba^+ is approximately 0.34. In addition, the oscillator strengths of the 5^2D–6^2P transitions of Ba^+ have been determined, and found to be about twice as large as those calculated by the Coulomb approximation. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-25600# Joint Publications Research Service, Washington, D. C.
STUDIES IN PHYSICAL TRAINING FOR WEIGHTLESSNESS
17 May 1965 18 p ref Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 1, 1965 p 44–47, 64–70
(JPRS-30111; TT-65-31006) CFSTI: $1.00

CONTENTS:
1. FLIGHTS AND PHYSICAL TRAINING B. Yevstaf'yev p 1–6 (See N65-25601 15-05)
2. TRAINING OF A HUMAN BEING FOR WEIGHTLESSNESS A. Yeremin et al p 7–15 ref (See N65-25602 15-05)

N65-25601 Joint Publications Research Service, Washington, D. C.
FLIGHTS AND PHYSICAL TRAINING
B. Yevstaf'yev *In its* Studies in Phys. Training for Weightlessness 17 May 1965 p 1–6 (See N65-25600 15-05) CFSTI: $1.00

Exercises connected with strength and static tension were alternated with exercises in relaxation, breathing, and bearing to develop the strength of certain muscles, increase the power and increase the static endurance of flying personnel. Test subjects who underwent static exercises for 2.5 months developed a higher ability to endure prolonged power and static tensions, than those who only undertook dynamic exercises. The best results were found in a group undergoing mixed exercise training. G.G.

N65-25602 Joint Publications Research Service, Washington, D. C.
TRAINING OF A HUMAN BEING FOR WEIGHTLESSNESS
A. Yeremin et al *In its* Studies in Phys. Training for Weightlessness 17 May 1965 p 7–15 ref (See N65-25600 15-05) CFSTI: $1.00

Considerations of the various physiological body mechanisms under conditions of weightlessness led to the following training recommendations for astronauts: neuropsychic stability training by prolonged isolation in a soundproof chamber; vestibular training by use of swings and rotating stands; and direct exposure to weightlessness of 25 to 45 second duration in parabolic flights. It was concluded that a high stability to weightlessness can be obtained under terrestrial conditions through purposeful medico-biological training. G.G.

N65-25675# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
AN INVESTIGATION OF LIGHTING IN DISPLAYS WITH SUPERIMPOSED FIELDS WHILE AT LOW LEVELS OF ILLUMINATION
Richard F. Gabriel, Leon R. Uyeda, and Alan A. Burrows Feb. 1965 62 p refs
(Contract Nonr-4348(00))
(AD-613344)

A study was performed to determine which of several alternate lighting configurations resulted in the best dual field performance. Both red and white light were used. The concept of pulsed or intermittent lighting was investigated. Based on Wald's two route theory of rhodopsin regeneration, it was hypothesized that pulsed light might maintain a high level of dark adaptation for the ambient field while providing satisfactory performance on the superimposed display information. A three-dimensional factorial experimental design allowed the simultaneous evaluation of the intermittency and lighting variable. The task involved performing a continuous compensatory tracking task while simultaneously performing an alphanumeric detection-recognition task on moving elements. Results supported the use of white light, at least for the luminance levels used in this experiment (1.0 FT-L for tracking task; 0.005 FT-L for detection-recognition task). Pulsed white light at a high light-dark ratio and high interruption frequency resulted in performance on a level with that obtained with continuous white light and superior in every instance to that obtained with red light. Author

N65-25770# Pittsburgh Univ., Pa. Engineering Psychology Lab.
INVESTIGATION OF MACHINE-ASSISTS TO OPERATOR PERFORMANCE: SIGNAL DETECTION AND TASK COMPLEXITY Final Report
Richard A. Regan and Wilson A. Judd Jan. 1964 31 p refs
(Contract Nonr-624(11))
(AD-605713)

A review was made of the human engineering literature to isolate general machine-assist principles and to determine implications for application to the machine-aiding of human performance. Investigations were carried out in the general area of signal detection to study the facilitating properties of overt observing responses, artificial signals and display, and control complexity on operator performance. The effects of task complexity on decrement over time in the performance of a signal detection task were investigated. The independent variables consisted of variation in signal rate, the number of signal sources, and the complexity of the required post-detection response. Signals consisted of changes in repeatedly presented alphabetical characters. Contrary to previous investigations, detection performance was not significantly influenced by variations in task complexity. Results are discussed in terms of arousal theory and of possible performance-facilitating properties of familiar symbolic stimuli. Author

N65-25905# Berkeley Inst. of Psychological Research, San Francisco, Calif.
BEHAVIORAL RESEARCH DURING THE 1963 AMERICAN MOUNT EVEREST EXPEDITION; CORRELATES OF FIELD BEHAVIOR
James T. Lester, Jr. Mar. 1965 74 p refs
(Contract Nonr-4672(00))
(TR-1; AD-613058)

The report summarizes one aspect of the behavioral research done on the 1963 American Mt. Everest Expedition, viz., the correlation between certain criterion variables (field-behavior) and pre-expedition personality assessment results. Section II explores the nature of the criterion variables; section III presents and discusses the assessment correlates. It appears that the responses of subjects on assessment techniques were valid samples of certain kinds of behavior which were later to be seen in the field, and which carried weight in the sociometric nominations used as criteria. The personological implications from all sources of data reported on show a high degree of congruence, which is encouraging with regard to the goal of developing techniques for predicting interpersonal performance in extreme environments. Author

N65-25925*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT-VEHICLE SYSTEM SIMULATION FOR LOW-ALTITUDE, HIGH-SPEED FLIGHT
Melvin Sadoff and Thomas E. Wempe Washington, NASA, Jun. 1965 51 p refs Presented at AGARD Interpanel Meeting on Low-Altitude, High-Speed Flight, Paris, 20–23 Oct. 1964
(NASA-TN-D-2793) CFSTI: HC $3.00/MF $0.50 CSCL 05H

Piloted simulator studies were made in areas where additional research appeared desirable. The vehicle simulated had variable wing sweep and was capable of supersonic speed at low altitude. The utility of the piloted flight simulator for examining and evaluating anticipated problem areas for the low altitude, supersonic speed penetration mission is indicated. Information is presented on handling qualities and stability augmentation system requirements; display and control requirements; and on the effects of cockpit acceleration environment, including an oscillatory component, assumed to approximate a predominant structural mode, on terrain-following task performance. Author

N65-25943# North Carolina Univ., Chapel Hill. Psychometric Lab.
DECISION-THEORETIC AND EMPIRICAL INVESTIGATION OF SOME PROBABILISTIC DISCRIMINATION LEARNING SITUATIONS
Raymond A. Wiesen Bedford, Mass., AFSC, Electron. Systems Div. Jan. 1964 115 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-64-192; AD-614682)

A decision-theoretic analysis and experiment of three related choice situations is presented. The first situation is a standard probabilistic discrimination learning task. Each trial begins with the presentation of one of a set of stimuli. The subject must choose between two response alternatives to predict which of two events will occur on the trial, the probability of each event being a function of the stimulus presented. The second situation arises when the conditional probabilities, i.e., the probabilities of the stimuli given the events, are introduced to the subject at the beginning of the experiment. The third situation is like the second except for the fact that the subject is not told which event occurs on each trial. The decision-theoretic analysis shows what differences in performance would be expected among the three conditions when a strategy which maximizes average expected payoff is employed. One group of subjects was run in each situation with the overall relative frequency of one event equal to .80. The performance of the subjects in the first and second situations was virtually identical, while the performance of the subjects in the third (non-feedback) was somewhat worse. The performance measure was the sum of the differences between the objective expected payoff of the optimal choices and the choices made by the subject. Comparisons of the choice proportions for the first and second groups indicated that subjects in the second group did not integrate information concerning the overall relative frequencies of events and conditional probabilities. A large proportion of subjects in the third (non-feedback) group made every choice in agreement with the assumption that the overall relative frequency of one event was one-half. Author

N65-26003# Arizona Univ., Tucson. Sensory Systems Lab.
NERVE CODING STUDIES. PHASE II: INSTRUMENTATION Final Report
Glen F. Ingle and Howard A. Baldwin 1 Jan. 1965 35 p refs
(Contract DA-49-092-ARO-28)
(AD-612908)

Several solid state ultrasonic transmitting instruments for observing physiological variables in untethered animals and for monitoring environmental factors are described. The application of these ultrasonic devices to the telemetry of the electrocardiogram, body temperature, and diving depth are discussed. Circuit descriptions are presented for a 50 Kc ultrasound FM receiver, an underwater radiofrequency transmitter, a high input impedance circuit for nerve pulse detection, and an implanted radiofrequency transmitter for accurate temperature telemetry. R.N.A.

N65-26109# North Carolina Univ., Chapel Hill. Psychometric Lab.
SEQUENTIAL INFORMATION SEEKING: AN OPTIMAL STRATEGY AND OTHER RESULTS
David M. Messick Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1964 16 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-64-605; AD-614685)

This paper presents an optimal strategy for sequential sampling from binomial distributions. The strategy presented is general in that it is a "multi-action" rather than a two-action procedure. While the major task is to estimate the proportion, p, of "successes" in a hypothetical, infinite population of binary observations, it is assumed that the decision maker is only concerned with which of a set of mutually exclusive and exhaustive subsets of the unit interval contains p. The derived strategy maximizes the decision-maker's gain without regard to error probabilities. The important variable in determining a rule for ceasing to look at new data and making a decision is found to be the expected probability of being correct. The criterion involves only the economic aspects of the situation. A "no information" theorem is presented which shows that under some circumstances when a "success" or a "failure" on a given trial are equally probable, the probability of being correct after making the observation is identical to the probability of being correct before the observation was taken. Finally, an appealing derivation of the Beta-binomial probability function is given which suggests a more tractable computational procedure for the distribution and which illuminates its limiting distribution. Author

N65-26118# Bunker-Ramo Corp., Canoga Park, Calif.
HUMAN ENGINEERING: PILOT FACTORS PROGRAM Final Summary Report, 1 Oct. 1964–31 Jan. 1965
A. C. Mc Tee and W. F. Swartz Feb. 1965 20 p
(Contract AF 33(615)-2214)
(AD-612726)

The work reported in this study represents a portion of the continuing effort to define the pilot factors essential to successful all-weather landing. The program is described in three general activity areas, which are called respectively the T-39, T-29, and Consulting areas. These areas are characterized by a common plane of approach: technical direction and furnishing

of project equipment by the Lear-Siegler engineering support group; development of instrument flying procedures and inflight conduct of studies by the Instrument Evaluation Section; and development of measurement techniques, data, collection, reduction, and analysis by the Bunker-Ramo support group. Each of the three problem areas, T-39, T-29, and Consulting, is discussed as an entity with the problems and progress of the individual area placed in context. N.E.A.

N65-26121# North Carolina Univ., Chapel Hill. Psychometric Lab.
SEQUENTIAL INFORMATION SEEKING: EFFECTS OF THE NUMBER OF TERMINAL ACTS AND PRIOR INFORMATION
David M. Messick Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1964 15 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-64-606; AD-614708)

An experiment was conducted by means of a digital computer in which 54 human *Ss* were faced with the task of sampling from a hypothetical binomial universe in which a proportion, p, of all observations were "top quality." *Ss* sampled the universe sequentially, stopping after some number of observations had been made to make a terminal decision by selecting the one of the *S*'s mutually exclusive and exhaustive subsets of the unit interval which *S* believed contained p. The four experimental treatments were defined by the four combinations of the two decision partitions of the unit interval, one involving 3 possible terminal acts, the other having 5 alternatives, and the two prior frequency distributions, one a rectangular distribution over [0 - 1] the other being negatively skewed. Analysis of variance of the number of predecision observations taken indicated a) significant individual differences; b) significant *S* by treatment interactions; c) differences attributable to the decision partitions with more observations being taken in the 5-act case than in the 3-act case; and d) no effect of prior frequency distributions, but a tendency to take more observations in the second 16 trials than in the first 16. Author

N65-26145# Naval Ordnance Test Station, China Lake, Calif. Aviation Ordnance Dept.
VISUAL DETECTION OF TARGETS: ANALYSIS AND REVIEW
Ronald A. Erickson Feb. 1965 65 p refs
(NOTS-TP-3645; NAVWEPS-8617; AD-612721)

This report discusses many of the aspects of air-to-ground visual search for targets. Curves are presented that can be used for estimating the probability that a ground target is within view and for determining the angular rate of the target as measured with respect to the air observer. Optical aspects (clouds, atmospheric attenuation, reflectance factors) of visual detection are discussed briefly and references from which data can be obtained are cited. A number of laboratory experiments concerning visual detection are described, and some of the results are given. Examples of simulation, operational, and mathematical methods of obtaining estimates of search performance are given and compared. Author

N65-26237# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
A WIDE BAND FREQUENCY AUDITORY TEST SYSTEM FOR USE WITH PRIMATES Final Report, 1 Apr. 1962–1 Apr. 1964
Gregg A. Gilbert and Gale H. Kaplan May 1965 14 p refs
(ARL-TR-65-5; AD-463489)

Although it is generally accepted that most humans cannot hear tones above 20,000 cps, data collected using extended range techniques indicate that many animals can hear tones much higher than this. In order to verify and extend data in the area of hearing, particularly that of primates, a system was developed which allowed for auditory testing in the frequency range of 40 cps to 40,000 cps without any extraneous cues to the test subject. These frequencies were generated with either of two transducers. Tones in the range from 40 cps to 20,000 cps were generated with an electrodynamic high fidelity headphone. Tones in a range of 10,000 cps to 40,000 cps were generated by driving a small condenser microphone as a loudspeaker. Both of the transducers were driven by a precision oscillator. The voltage signal from the oscillator to a transducer was turned on or off with an electronic switch. The electronic switch eliminated any "click" that would be transmitted with the tone.

N65-26316# Youngstown Univ., Ohio. Dept. of Chemistry
INVESTIGATION OF THE USE OF BIOCHEMICALS IN TECHNIQUES OF CO_2 SEPARATION AND CONCENTRATION IN AEROSPACE VEHICLE ATMOSPHERE REGENERATION PROCESSES Quarterly Technical Report
Eugene D. Scudder et al Aug. 1964 87 p refs
(Contract AF 33(615)-1777)
(QTR-1; AD-460941)

The use of the enzyme carbonic anhydrase in controlling the absorption, storage, and release of carbon dioxide, to maintain breathing conditions in spacecrafts, was investigated experimentally. Under laboratory conditions it was found that when the enzyme is introduced into a buffer at low pressure, rapid absorption of carbon dioxide is feasible. Desorption of carbon dioxide from a buffered aqueous solution can be rapidly accomplished either by lowering the pH or by lowering the partial pressure of the carbon dioxide in contact with the solution in the presence of the enzyme. Aqueous Tris solutions were found to be good absorbents for carbon dioxide. A redox couple can effect reversible changes in the pH of dilute or moderately concentrated solutions, by means of controlled potential electrolysis, with very little gas evolution from the water. The stability of certain carbonic anhydrase preparations in buffered solutions makes the technical use of this enzyme feasible. J.M.D.

N65-26347# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
AN INVESTIGATION INTO THE ROLE OF THE CORTICAL COMPUTING UNIT IN HUMAN VISUAL PATTERN RECOGNITION
Oscar Eugene Williams, Jr. (M.S. Thesis) Aug. 1964 185 p refs
(GE/EE/64-22; AD-608086)

It has been postulated that the neurons in the cerebral cortex are arranged so that the cortex is functionally a sheet of individual computing units coupled together horizontally and processing information perpendicularly through the sheet in a process described mathematically as correlation. A digital computer model is developed which simulates the proposed correlation function performed by the human visual system and is evaluated on the IBM 1620 and IBM 7094 digital computers. The computer model performs: 1) storage of a number of patterns; 2) correlation between input and stored patterns; 3) pattern translation correction; 4) pattern recognition; 5) pattern similarity recognition and short term memory simulation; 6) memory allocation. Recommendations are made for Fourier transform analysis, pivoted pattern analysis, and magnification effect correction. Author

N65-26570# School of Aerospace Medicine, Brooks AFB, Tex.
FATIGUE EFFECTS IN 24-HOUR SIMULATED TRANSPORT FLIGHT: CHANGES IN PILOT PROFICIENCY
Bryce O. Hartman Apr. 1965 9 p refs
(SAM-TR-65-16; AD-464380)

Each of four pilots completed a 24-hour simulator flight broken into eleven 2-hour legs terminated by an Instrument Landing System (ILS) landing. Two kinds of performance measures are presented: (a) 20-second time-lapse photographs recorded airspeed, altitude, and rate of climb (or compass heading) through cruise portions of each leg; and (b) the ground-track record of the ILS approach was photographed after each landing. The cruise portions of each leg showed an increasing variability in performance, but this change did not significantly reduce overall system efficiency. Instrument approaches were carried out at a high level of proficiency for approximately 20 hours, at which point there was a precipitous drop in performance. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-25578# FMC Corp., Princeton, N. J. Chemical Research and Development Center

SYNTHESIS OF HIGH-STRENGTH CHEMICAL RESISTANT ELASTOMERS FOR EXTREME TEMPERATURE SERVICE Final Report

E. W. Cook, C. A. Erickson, and J. A. Gannon Jan. 1965 85 p refs

(Contract DA-19-129-AMC-147(N))

(C&OM-4; AD-463850)

The synthesis of new fluorinated elastomers serviceable at low temperatures is described. Hexafluoroacetone and hydrogen-containing olefins have been found to form both low polymers and hydrogen-containing oxetanes on actinic irradiation. Evidence is presented to show that the intermediate is a biradical. A new elastomer system has been discovered involving the condensation of a polyfluorinated diol with a fluorocarbon diene. This unique fluorinated polyether has been found to have a very low T_g (−54° C). Evidence has also been found that a polyfluorinated diol will condense with hexafluorobenzene. Polyurethane polymers have been successfully formed by condensation of a polyfluorinated diol with phosphorous containing diisocyanates. Several new monomers are described. Author

N65-25620# Chicago Univ., Ill. Lab. of Molecular Structure and Spectra

[EMISSION SPECTRA, ENERGY LEVELS, AND MOLECULAR STRUCTURE] Quarterly Status Report, 1 Oct.–31 Dec. 1964

Robert S. Mulliken [1964] 8 p

(Contract Nonr-2121(01))

(QSR-32; AD-613579)

Work was performed in the following areas: *Emission Spectrum of He_2*—analyses of new vibrational bands in several transitions; *Rydberg–Klein–Rees Potential Energy Curves*—determination of uncertainties in potential curves; *Emission Spectrum of AlO*—development of a source which yields very intense emission spectra from the AlO molecule; *Emission Spectra of Hydrides of Cu, Ag, and Au in the Extreme Ultraviolet*—modification of the electrode assembly to overcome cooling difficulties. *Absorption Spectra of Halogens in the Ultraviolet*—transient absorption spectra of chlorine and bromine; *Emission Spectrum of ($SiCl_4 + O_2$)*—new plates to reduce impurity bands in spectra; *A New Absorption Spectrum of ($Xe + F_2$) in the Region 3540 Å to 2340 Å*—detailed study of a spectrum obtained by flash-photolyzing a mixture of Xe and fluorine; *The Emission Spectrum of Cl_2*—photographs of the region from 4600 Å to 5100 Å were obtained and 12 new bands were analyzed; data on the He_2 molecule were obtained and reduced. G.G.

N65-25648# Mound Lab., Miamisburg, Ohio.

MOUND LABORATORY PROGRESS REPORT FOR MARCH, 1965

J. F. Eichelberger, G. R. Grove, and L. V. Jones 4 Jun. 1965 37 p refs

(Contract AT(33-1)-GEN-53)

(MLM-1250)

The following studies were performed: *Radioelements*—polonium 208 and 209, polonium half-life determination by decaying pairs, uranium 234, potassium plutonium sulfate calorimetric standard, and franconium 233 decay; *Alpha and Neutron Source Development*—calorimeter measurements of PuBe source; *Isotope Separation and Purification*—carbon 13, helium, neon, argon, krypton, xenon, oxygen, and thermal diffusion research; *Analytical and Instrumentation*—calorimetry, counting analyses of tritium and krypton 85, isotopic analysis of boron by neutron absorption, and controlled potential coulometry of uranium–iron–nickel solutions; and *Organic Research*—adhesive shrinkage studies. G.G.

N65-25649# Argonne National Lab., Ill.

CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, MAY 1964–APRIL 1965

R. C. Vogel, M. Levenson, and F. R. Masten [1965] 275 p refs

(Contract W-31-109-ENG-38)

(ANL-7020) CFSTI: $6.00

Work was accomplished in the following areas; (1) processes and equipment for the recovery of fissionable and fertile materials from spent nuclear fuels; (2) methods for the synthesis and production of nuclear reactor fuels and materials; (3) methods for the direct conversion of heat into electricity; (4) chemical and physical behavior of nuclear reactor fuels and materials suitable for use at high temperatures; (5) unit operations in nonaqueous systems; (6) chemistry of substances of interest to nuclear technology, which also provide basic data to the scientific community; (7) chemical reactions important to the safe handling of nuclear fuels and the safe operation of nuclear reactors, and the correlation of laboratory-derived data with conditions existing in nuclear reactors; (8) nuclear constants, particularly neutron cross-sections of elements that are of importance to the design and performance of fast breeder reactors; (9) alternative methods for reprocessing fast breeder reactor fuels; and (10) analytical chemistry in support of the research and development programs. Author

N65-25681# Louisiana State Univ., Baton Rouge. Coates Chemical Lab.

ELECTRODE KINETICS AT OPEN CIRCUIT AT THE STREAMING MERCURY ELECTRODE. I: THEORY

Paul Delahay Jan. 1965 17 p refs Submitted for Publication

(Contract Nonr-1575(04))

(TR-55; AD-612662)

A general equation is derived for the potential, at open circuit, of an electrode of varying area at which a charge transfer process occurs. Application is made to the streaming mercury electrode for which there is continuous renewal of the double layer. The steady-state overvoltage is derived for mixed control by charge transfer and mass transfer for any value of the overvoltage. Simplified equations are given for small overvoltages

(≤ 5 millivolts). Limiting cases are analyzed. Application to electrode kinetics in media of low conductivity is considered, and two expected difficulties are indicated. Author

N65-25682# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.

ELECTRO-OPTICAL MATRIX DISPLAY Interim Development Report, 1 Nov. 1964–31 Jan. 1965

Mar. 1965 27 p
(Contract NObsr-91199)
(IDR-480-Q3; AD-613721)

Further work on film preparation parameters resulted in good display properties combined with lower coercive force. These results were obtained using melt compositions of 83/17 Ni-Fe, high evaporation rates, and high substrate temperature. A substantial development effort in preparation of display colloid has resulted in a good understanding of the nature of the several processes that can be used. Good control in the colloid preparation is possible with a process based on forming (1) a seed solution of particles of small and very uniform size, (2) controlledly enlarging the seed particles, and (3) adding the magnetic property. Techniques of panel module assembly were studied including edge encapsulation, inner bonding, and silk screening. Experimental cells were made that have shown no sign of seal deficiency after five months. Author

N65-25728# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.

STUDY OF THE MECHANISMS OF PYROLYTIC DEPOSITION–NUCLEATION AND GROWTH OF NICKEL

R. W. Coutant, N. Albon, and J. F. Miller 24 Aug. 1964 18 p refs
(Contract AF 33(657)-11673)
(IER-1)

The deposition of nickel from nickel carbonyl onto amorphous substrates was studied, with emphasis on the specific effects of the physical and chemical, and chemical nature of the substrate, and to the effect of oxygen on the crystal morphology. With substrates having microscratches or etch lines, nucleation occurred preferentially at these surface features. Flame polishing of the substrate surfaces was found to remove any regularity in preferred nucleation sites. Nucleation occurred less readily on substrates having relatively low surface energies, e.g., Teflon and carbon, than on materials having relatively high surface energies such as fused silica. At low oxygen concentrations [$Ni(CO)_4/O_2 \geq 54 \times 10^3$], apparently pure and well-formed nickel crystals were observed to nucleate and grow irrespective of the presence of oxygen. At higher concentrations of oxygen, a secondary growth process, dependent upon oxygen concentration and resulting in a gradual change in crystal morphology, was observed. It is concluded that the influence of oxygen on the nucleation and growth of nickel is determined by the relative kinetics of the various possible reactions, and that under the experimental conditions employed, the oxygen-nickel interaction occurs at some nucleation or prenucleation stage. Author

N65-25747# Radiation Applications, Inc., Long Island City, N. Y.

RADIATION-INDUCED SOLID PROPELLANT DECOMPOSITION Final Technical Report

15 Jan. 1965 28 p refs
(Contract AF 49(638)-1125)
(RAI-347; AFOSR-65-0429; AD-612536)

Radiation effects were studied on the deflagration rates of propellant binder and oxidizer apart from each other and independent of additives or other substances, and the chemical products of ammonium perchlorate radiolysis. Irradiated ammonium perchlorate was analyzed for its chlorate, chlorine dioxide, chlorite, hypochlorite, chlorine, chloride, and total nitrite and nitrate content. The radiolytic yields are tabulated. The products of metal and ammonium perchlorate radiolysis were compared. Chlorate is a major product for both but ammonium chlorate also has major yields of chloride and chlorine. Using a porous-plug burner technique, irradiated and non-irradiated solid ammonium perchlorate oxidizer and solid polystyrene fuel specimens were burnt in unirradiated gaseous methane fuel and gaseous oxygen oxidizer environments and their burning rates measured as a function of dose level. Irradiation resulted in an acceleration of the ammonium perchlorate burning rate and was greater at higher methane flow rates. Radiation decreased the burning rate of polystyrene with the effect greater at the lower oxygen flow rate. Irradiation increased the burning rate of solid mixtures of polystyrene and ammonium perchlorate but to a lesser degree than with ammonium perchlorate alone. R.N.A.

N65-25765# Stanford Univ., Calif.

DIRECT ENERGY CONVERSION SYSTEMS. SUPPLEMENT 3: THE ANODIC OXIDATION OF METHANOL ON SINGLE CRYSTAL AND POLYCRYSTALLINE PLATINUM Quarterly Technical Summary Report, 1 Mar.–31 May 1964

Wilson Smart and David M. Mason 4 Jun. 1964 118 p refs
(Contract AF 49(638)-1123; ARPA Order 246)
(AD-460947)

The anodic oxidation of methanol on single-crystal and polycrystalline platinum electrodes in acid solution was investigated using potentiostatic sweeping. The effect of doping the platinum electrodes with small concentrations of other metals was studied with a view to finding ways to enhance the electrocatalytic activity of electrodes for fuel cell applications. No differences in electrochemical behavior for the anodic oxidation of methanol were noted for single-crystal platinum as compared with polycrystalline platinum. Electrodes doped with iron, nickel, manganese, copper and zinc did not exhibit electrochemical activity that was significantly different from undoped platinum. Voltammetric curves of platinum in the electrolyte in the absence of methanol suggest that the methanol oxidation reaction is controlled by the oxidation state of the platinum electrode surface. J.M.D.

N65-25768# Bureau of Mines, Bartlesville, Okla.

HEATS OF FORMATION AND THERMODYNAMICS OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Quarterly Technical Summary Report, No. 23, 1 Jul.–30 Sep. 1964

D. R. Douslin, W. D. Good, N. K. Smith, R. T. Moore, and Ann Osborn Oct. 1964 9 p
(ARPA Order 416)
(AD-461002) (Declassified)

Research on this project is directed towards heat-of-combustion and heat-of vaporization measurements on compounds of significance to chemical propulsion. Experimental measurements of the heat of combustion of a compound containing nitrogen and fluorine were completed. This material apparently decomposed in the vapor phase on the metallic surfaces of the inclined-piston gage; hence an estimate of the value of the heat of vaporization was necessary. Research on three other samples of this nature is in various stages of progress. Experimental measurements of the heat of combustion of dekazene were concluded. Calculation of results is in progress. Author

N65-25794# American Meteorological Society, Boston, Mass.

OXIDATION OF HYDROGEN ON A POROUS NICKEL ELECTRODE [OKISLENIE VODORODA NA PORISTOM NIKELEVOM ELEKTRODE]

O. S. Ksenzhek and E. A. Kalinovskii Bedford, Mass., ARCRL, Nov. 1962 Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 37, no. 6, 1964 p 1256–1260 refs
(Contract AF 19(628)-3880)
(T-R-457; AD-612497)

Elevation of the sintering point of the electrodes reduces the activity of their surface (diffusion current); oxidation and subsequent reduction loosens and activates the surface of the nickel. The macroscopic polarization characteristics of porous electrodes are determined both by their kinetic and their structural properties. The electrodes studied were compared with each other and with a smooth nickel electrode and it was found that the best of the porous electrodes was 1000 times more active than the smooth nickel electrode. Author

N65-25824# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Lab.
ROTATIONAL ISOMERISM AND MICROWAVE SPECTROSCOPY. III: THE MICROWAVE SPECTRUM OF 3-FLUOROPROPENE
Eizi Hirota [1964] 64 p refs Sponsored by ONR
(AD-612475)

The 3-fluoropropene molecule has been confirmed by microwave spectroscopy to exist in two rotational isomers, cis and gauche. Rotational constants in the ground vibrational state are A = 17236.63_8, B = 6002.91_5, C = 4579.82_7 Mc/sec for the cis and A = 27720.34_9, B = 4263.62_8, C = 4131.98_4 Mc/sec for the gauche. Rotational transitions are assigned for isotopic species, eight of cis and nine of gauche. By using Costain's method, the molecular structure is determined separately for the two isomers. The dipole moment and its components along the principal axes of inertia are $\mu_a = 0.74_2 \pm 0.008$, $\mu_b = 1.60_1 \pm 0.011$, $\mu_{total} = 1.76_5 \pm 0.014$ D for cis and $\mu_a = 1.59_5 \pm 0.006$, $\mu_b = 0.90_8 \pm 0.012$, $\mu_c = 0.62_3 \pm 0.014$, $\mu_{total} = 1.93_9 \pm 0.015$ D for gauche. Through the temperature dependence of the intensity ratio, the cis form is found more stable than the gauche form by 166 ±67 cal/mole. Author

N65-25830# Naval Research Lab., Washington, D. C. Chemistry Div.
INVESTIGATIONS OF THE KINETICS OF HYDROGEN AND OXYGEN REACTIONS ON A PLATINUM ELECTRODE IN ACID SOLUTION USING PULSE AND DECAY TECHNIQUES
S. Schuldiner and T. B. Warner 4 Sep. 1964 17 p refs
(NRL-6136; AD-613654)

The influence of hydrogen partial pressure, current density, and temperature on the anodic oxidation of sorbed H and the anodic generation of sorbed O were determined. Electrode processes gave the following quantities: (a) amount of H associated with a Pt surface and its immediate vicinity; (b) extent of reaction of H atoms, absorbed in the metal interior, that migrate to the surface of the metal and either ionize or react with O atoms; (c) extent of reaction of H_2 from the solution phase; (d) amount of O absorbed on the Pt surface; and (e) amount of O absorbed in the Pt surface layers (skin). The kinetics of the open-circuit reaction of galvanostatically determined amounts of sorbed O with H_2, which significantly affect coulometric measurements at pulse lengths longer than about 1000 μsec. The presence of absorbed O in the Pt can also materially affect the reaction rate of chemisorbed O with H_2. Under the experimental conditions transport of reactants on the solution side was fast enough so that diffusion did not limit processes in either the H ionization or O sorption regions. The data indicated that migration of absorbed species on the Pt surface to active sites was rate controlling in the O sorption region, except in the case of reaction of adsorbed O with H_2 when significant amounts of O were adsorbed in the skin of the Pt. Here, rate between adsorbed O and H_2 was retarded so that this chemical step appeared to be rate determining. Reaction rates of the adsorbed O and H_2 reaction under open-circuit conditions were determined at varying temperatures, adsorbed and adsorbed O concentrations, and H_2 partial pressures. Author

N65-25843# California Univ., Berkeley. Lawrence Radiation Lab.
THE PURIFICATION OF PLUTONIUM BY ELECTROLYSIS OF THE SOLID METAL
W. Z. Wade and T. Wolf 15 Apr. 1965 15 p
(Contract W-7405-ENG-48)
(UCRL-14128) CFSTI: $1.00

Transport of impurities within the plutonium lattice under the impress of dc voltage with heavy current flow was investigated. Each rod (1/4 in. diameter × 4 in. long) of alpha plutonium metal was raised to 500° C in a vacuum, with 100 dc amperes sent through it, and these conditions were maintained for periods of 100, 200, 500, and 1000 hr. Complete spectrographic analyses were made for all metallic impurities, with primary attention on the migration of iron. One of the major impurities in alpha plutonium is iron whose concentration along the test bars at the completion of these runs was quite markedly affected. At 1000 hr, with a starting concentration of 336 ppm Fe in the original material, 35% of the bar nearest the cathode had 60 ppm; while the extreme anode end had in excess of 820 ppm Fe. Rods run at smaller time periods also had marked concentration gradients, but not quite as extreme. Author

N65-25880# Stanford Research Inst., Menlo Park, Calif.
HIGH TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM Final Report, Jul. 1, 1963–Oct. 31, 1964
R. A. Pasternak Washington, AEC, 15 Nov. 1964 65 p refs
(Contract AT(04-3)-115)
(SRIA-132) CFSTI: $3.00

An intensive ultrahigh vacuum study of the interaction of nitrogen of oxygen, and of nitrogen-oxygen mixtures with clean niobium has been carried out. For nitrogen the kinetics of adsorption, absorption, and degassing has been investigated, and the thermodynamic equilibrium for solution of nitrogen in niobium has been determined. Detailed mechanisms for these processes have been formulated. The study of the oxygen-niobium system resulted in data on the adsorption and absorption processes similar to that for nitrogen. Dissociation of oxygen molecules on the hot metal surface and evaporation of a volatile niobium oxide from the hot sample were observed. The reaction of nitrogen-oxygen mixtures at low pressures with niobium cannot be explained on the basis of independent sorption of the individual gases with niobium. Possibly a catalytic reaction leading to nitrogen oxides may occur; the formation of stable surface layers containing both nitrogen and oxygen is also indicated. Author

N65-25883# Oak Ridge National Lab., Tenn. Chemical Technology Div.
LABORATORY DEVELOPMENT OF PROCESSES FOR FIXATION OF HIGH-LEVEL RADIOACTIVE WASTE IN GLASSY SOLIDS. 3: WASTES FROM THE PUREX SOLVENT EXTRACTION PROCESS
W. E. Clark, H. W. Goodbee, and C. L. Fitzgerald Jun. 1965 59 p refs
(Contract W-7405-ENG-26)
(ORNL-3640) CFSTI: $3.00

Glassy solids suitable for the long-term storage ("ultimate disposal") of radioactive wastes were prepared from

solutions simulating those obtained or expected from the processing of nuclear fuel by the Purex solvent extraction process. The studies were applicable to both rising level (RL-Potglass) and continuous glass (Con-Potglass) processes. The simulated waste solutions studied varied from those in which sodium sulfate was the principal constituent to those which contained no sulfate. Simulated fission products varied from zero to amounts expected from a burn-up of 35,000 Mwd/metric ton. Actual radioactivity was limited to tracer amounts used in determining leaching rates and volatilities. Minimum volumes of "glass" obtained (at 0.2% simulated fission products) corresponded to about 2.7 gallons of solid per ton of uranium processed. This solid contained 46% (by weight) waste oxides (process oxides plus simulated fission products), 31.5% P_2O_5, 11.8% Al_2O_3, 7.4% Li_2O, and 4.9% CaO. Melts incorporating higher concentrations of fission products required higher percentages of fluxing agents to keep melting temperatures and viscosities low enough for practical operation in stainless steel equipment. Maximum temperatures allowable are about 1050° and 900° C for the rising level (RL-Potglass) and the continuous melting glass (Con-Potglass) processes, respectively; lower operating temperatures are desirable in both cases. Author

N65-25903# Monsanto Research Corp., Everett, Mass.
CHEMILUMINESCENT SYSTEMS Technical Report No. 3
22 Mar. 1965 25 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009Q3; AD-613013)

Continued research on the chemiluminescence of selected autoxidation reactions in basic aprotic media, is reported. Presented are experimental results of studies on acyloins and indoles. Included is a cumulative summary of the brighter reactants and the bright initial flash reactants. It is shown that acyloin oxidation generally leads to chemiluminescence and that relatively simple structural variation may lead to striking modification of system behavior. Data on the chemiluminescence and fluorescence spectra of skatole in dimethylsulfoxide and potassium t-butoxide solutions, the dependence luminescence and fluorescence spectra of skatole in dimethylsulfoxide and potassium t-butoxide solutions, the dependence of the skatole peak emission intensity upon skatole concentration at a fixed based concentration, and the oxidation peak emission of several 3-substituted indoles, are discussed. A review of instrumentation used in fluorescence and chemiluminescence measurements, is included. S.C.W.

N65-25909# Naval Research Lab., Washington, D. C. Chemistry Div.
CHANGES IN CONTACT POTENTIALS OF METALS CAUSED BY ADSORBED MONOLAYERS
K. W. Bewig, C. O. Timmons, and W. A. Zisman 12 Feb. 1965 28 p refs Presented at the Conf. on Surface Effects in Detection, Washington, D. C., Jun. 29–Jul. 1, 1964
(NRL-6200; AD-612509)

Recent advances in experimental techniques, especially the use of a fluorocarbon coating on the reference electrode, have made possible a number of advances in the study of the surface potential changes resulting from the adsorption of monolayers of nonpolar liquids and of the higher molecular weight polar compounds. Studies have been made of adsorbed non-polar liquid compounds, including the various hydrocarbons and carbon tetrachloride. Polar–nonpolar compounds, such as the homologous families of the fatty acids and amines, and aromatic phosphate esters, have been investigated with the new techniques. Measurements were made in the presence of atmospheric oxygen, nitrogen, and water vapors as well as any surface oxide development on the metal at ordinary temperatures. It was necessary to control the relative humidity and air temperature carefully, to use an atmosphere entirely free of organic vapors or polar inorganic compounds, to take great care in cleaning the metal surfaces, and to employ compounds of extremely high purity. Author

N65-25919# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
HIGH PRESSURE SYNTHESIS OF NEW SILICON SULFIDES
(Contract Nonr-2687(00))
(TR-44; AD-612607)

By heating mixtures of silicon and sulfur in various atomic ratios to temperatures of from 700° to 2300° C, at pressures of 25–80 kilobars (kb), a variety of reaction products resulted. In addition to the previously-known SiS_2 and SiS, these include several colored glasses and three new crystalline materials with distinctive X-ray diffraction patterns. Author

N65-25949*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
RECENT DEVELOPMENTS IN PERTURBATION THEORY
Joseph O. Hirschfelder, W. Byers Brown, and Saul T. Epstein [1964] 103 p refs Submitted for Publication
(Grant NsG-275-62)
(NASA-CR-63403; AD-425944) CFSTI: HC $4.00/MF $0.75 CSCL 7D

The techniques involved in some of the recent developments in low order perturbation theory are discussed in detail. These include: the close two-way relationship between the perturbation solutions and the variational principles; the existence of solutions to the perturbation equations and their convergence; the explicit and variational solutions of the first order perturbation equation; double perturbations and the calculation of expectation values; the determination of second order properties (such as polarizability); estimation of off-diagonal and time-dependent properties; fast converging iteration procedures; simplified treatment of degenerate or almost degenerate perturbations; sum rule techniques and their application to intermolecular forces; and a short survey of the atomic 1/Z expansion and Hartree–Fock applications of perturbation procedures. Author

N65-25970*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES IN SILAZANE CHEMISTRY
James D. Byrd and James E. Curry 1 Feb. 1965 37 p refs
(NASA-TM-X-53197) CFSTI: HC $2.00/MF $0.50 CSCL 7C

The chemistry of a number of silazane compounds has been studied in an effort to prepare polymers containing Si-N linkages. This effort has resulted in the discovery or development of some new and interesting polymeric materials. Polysilazanes having good thermal stability, elastomeric properties, and good film-forming properties have been prepared. A method has been developed for the preparation of an elastomeric silazane from dimethyldichlorosilane and ethylenediamine. This material has good thermal stability and remains rubbery after extended exposure to elevated temperatures (300–400° C). Polymers having a number of useful properties were prepared the polymerization of equimolar amounts of hexaphenylcyclotriazane and a number of different aromatic diols such as p,p'-biphenol. Author

N65-25992# National Research Corp., Cambridge, Mass. Research Div.
THERMODYNAMIC PROPERTIES OF BIMETALLIC COMPOUNDS Quarterly Letter Report, 1 Oct.–31 Dec. 1963

Ludwig Fasolino 31 Dec. 1963 6 p
(Contract Nonr-3608(00); ARPA Order 23-61)
(AD-612928)

Progress on the measurement of the heat of formation of boron and beryllium chlorides, fluorides, and oxides by solution calorimetric techniques is reported. A fluorine combustion calorimeter for the determination of AlB_2 and a silvered, dewar-type reaction vessel for the measurement of the heats of solution of B_2O_3, H_3BO_3, BCl_3, and BF_3 is also discussed. Combustions were carried out at various pressures of fluorine with boron and AlB_{12} in the form of loose powders and as pellets containing various portions of Teflon powder. The Teflon powder enabled the material to be pelletized and aided ignition. The conditions which yielded nearly 100% combustion of the products and unburnt sample required a fluorine pressure of 125 psig and a material to Teflon ratio of 1 to 4. E.E.B.

N65-26000# Army Engineer Research and Development Labs., Fort Belvoir, Va.
SPECTROPHOTOMETRIC STUDY OF COBALT CHLORIDE COMPLEXES IN MELTS [SPEKTROFOTOMETRICHESKOYE IZUCHENIYE KHLORIDNYKH KOMPLEKSOV KOBAL'TA V RASPLAVAKH]
I. V. Tananayev and B. F. Dzhurinskiy [1964] 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. SSSR, Ser. Khim. (Moscow), v. 134, no. 6, 1960 p 1374–1377
(ERDL-T-1780-65; AD-612961)

In studying the chloride complexes of Co^{2+} in a $LiNO_3$–KNO_3 melt, a spectrophotometer having a cell compartment with a massive block of stainless steel was used. The temperature in the furnace unit, supplied through a voltage stabilizer, was kept constant within one degree up to maximum operating temperatures of 900° C. The absorption spectrum of $Co(NO_3)_2$ was unaffected by the addition of up to 3% volume of water at 160° C and depended only slightly on temperature. Comparison of absorption bands indicated an octohedral coordination of cobalt ions in a nitrate melt, and a weakening of the ligand field of nitrate complexes as the band shifts toward the longwave region. As wavelength increased, the peak shifted toward the formation of compounds with a higher coordination number. M.W.R.

N65-26006# Airtron, Inc., Morris Plains, N. J.
HYDROTHERMAL GROWTH OF CRYSTALS OF $LaAlO_3$ Semiannual Technical Summary Report, 15 Aug.–31 Dec. 1964
[1964] 37 p refs
(Contract Nonr-4616(00); ARPA Order 306-62; Proj. Defender)
(R11-473; AD-614229)

$LaAlO_3$ has been successfully grown in a hydrothermal system below and above the transition temperature of 435° C. Using small autoclaves, growth has been observed in the temperature range of 400° C - 600° C in 7 m K_2CO_3 at 10,000 to 20,000 psi. A high pressure form of $La(OH)_3$ is also stable within this temperature and pressure range. Seed crystals up to 1/4 inches × 1/4 inches × 1/8 inches were grown from PbF_2 fluxes. These crystals are readily doped with Cr by the addition of Cr_2O_3 to the melt. Author

N65-26022*# Ionac Chemical Co., Birmingham, N. J.
NASA DESALTING KIT DEVELOPMENT, PHASE II First Progress Report
C. Calmon, W. Grundner, G. P. Simon, and E. A. Zink 12 Nov. 1964 35 p refs
(Contract NAS9-2580)
(NASA-CR-65022) CFSTI: HC $2.00/MF $0.50 CSCL 07A

A container design for a water desalting kit was completed, and several cans are being fabricated for test purposes. The revised text for the container, and the revised instructions for the processing bag are listed; and silk screens for printing the information are being prepared. Calibration of the bag was also completed. Tests were made for briquetting the blended desalting chemicals, and a briquetting die is being manufactured. Silver impregnated amorphous alumino silicate exchangers were blended with the high capacity materials already in use in an attempt to improve the structural strength of the briquets. Structural strength was increased, but at the cost of capacity. The addition of small amounts of stearyl alcohol to the briquets had a marked effect on its capacity without materially improving its strength or the surface dusting properties. Several binders were also evaluated, but failed to improve the physical properties of the briquets observed. Graphs of briquet physical properties, and changes with respect to capacity, density, pressure, strength, pH, and additives are given in support of the data. L.S.

N65-26028# Youngstown Univ., Ohio. Dept. of Chemistry
INVESTIGATION OF THE USE OF BIOCHEMICALS IN TECHNIQUES OF CO_2 SEPARATION AND CONCENTRATION IN AEROSPACE VEHICLE ATMOSPHERE REGENERATION PROCESSES Quarterly Technical Report
George Graf Nov. 1964 88 p refs
(Contract AF 33(615)-1777)
(QTR-2; AD-461055)

The feasibility of continuous CO_2 removal from air by enzymatically catalyzed reactions and the regenerability of the absorbing system is being investigated. It was found that, if air, containing 1% CO_2 by volume was passed, at the rate of 500 cc./min., through 1000 ml. of 0.02 M solution of 2-amine-2-(hydroxymethyl)-1,3-propanediol, containing 100 mg. carbonic anhydrase, more than 50% of the CO_2 is removed at a steady rate, during the period of the absorption of more than 60 minutes. Preliminary tests show that the system can be regenerated. If the regenerability of the system is satisfactory, scaling-up the model 1:100 would satisfy the requirements for a regenerable chemical system for CO_2 management in a one-man aerospace cabin. The apparatus for CO_2 absorption, procedure and results are presented in tabulated form and on graphs. Further work is carried out to integrate simple enzymatically controlled reactions into a carboxylation-decarboxylation cycle. Principles and general procedures are presented on this subject. Author

N65-26029# AeroChem Research Labs., Inc., Princeton, N. J.
EFFECTS OF CONVECTIVE DIFFUSION ON THE APPARENT KINETICS OF ZEROTH ORDER SURFACE-CATALYSED CHEMICAL REACTIONS
Daniel E. Rosner Aug. 1964 47 p refs
(Contract AF 49(638)-1138)
(TP-102; AD-461000)

The apparent kinetics of zeroth order surface-catalysed reactions are quantitatively investigated for several configurations involving laminar or turbulent boundary layer flow, with or without pressure gradient. Nine cases of interest are solved exactly in terms of the incomplete beta function and analytical and graphical results are presented and compared with the results of applying the familiar quasi-stationary approximation. The latter method, which is equivalent to the use of the concept of local resistance additivity, is shown to fail badly in this chemical kinetic extreme. Applications of the theory to the interpretation of kinetic data and the design of catalytic heat exchangers are discussed. Author

N65-26030# Leicester Univ. (England). Chemistry Dept.
A STUDY OF ION–ION AND ION–SOLVENT INTERACTIONS Quarterly Technical Status Report, Jul.–Sep. 1964
M. C. R. Symons [1964] 9 p refs
(Contract DA-91-591-EUC-3195)
(QTSR-3; AD-461050)

A study on ion–ion and ion–solvent interactions was continued and includes color formation in primary and secondary alcohols and other organic solvents when exposed to high energy radiation. Most solvents gave clear glasses when rapidly cooled in liquid nitrogen. Diethyl ether glassified occasionally but became polycrystalline when cooled slowly. T-butanol would not give a glassy state and acetone gave solids consisting of polycrystalline and glassy regions. Spectra were recorded before and after bleaching with visible light and in many cases bleaching was accompanied by a loss of a single symmetrical band in the free-spin region. Crystalline t-butanol and diethyl ether did not color during irradiation and the characteristic central line was not observed in the electron resonance spectra. Partially crystalline acetone was blue in the glassy regions but clear in crystalline areas. Isopropanol containing alkali metal fluorides became intensely violet after irradiation. Evidence supporting the concept that violet species in alcohols and blue species in ethers are trapped electrons is discussed. R.N.A.

N65-26041# Bureau of Mines, Reno, Nev. Metallurgy Research Center
HEAT OF FORMATION OF EUROPIUM SESQUIOXIDE AND EUROPIUM TRICHLORIDE
J. M. Stuve 1965 13 p refs
(BM-RI-6640)

Provisional values for the heat of formation of europium trichloride and europium sesquioxide were determined by solution calorimetry utilizing europium metal of more than 99-percent purity. The resulting values for the heats of formation of Eu_2O_3 (cubic) and $EuCl_3$ (hexagonal) were $-386,970 \pm 1,200$ cal/mole and $-218,740 \pm 650$ cal/mole, respectively, measured at 298.15° K. Author

N65-26046*# Western Ontario Univ., London. Dept. of Physics
CONDON LOCI OF DIATOMIC MOLECULAR SPECTRA
Mary Frances Murty (M.S. Thesis) 8 Oct. 1964 126 p refs
(Grants NsG-349; AF-AFOSR-62-236; Contract AF 19(628)-2820)
(NASA-CR-63237) CFSTI: HC $4.00/MF $1.00

The geometry in the v′v″ plane of Condon loci of diatomic molecular band systems is studied. Using both simple harmonic and Morse potential models it is shown that for most band systems the largest contribution to the overlap integral of the vibrational wave functions of a transition is from the coincidence of a single pair of antinodes of the wave functions. The coincidence of a pair of terminal antinodes describes the primary Condon locus, while the coincidence of a terminal and an internal antinode describes a subsidiary Condon locus in cases where the loci are nested. A single pair of coinciding antinodes does not control the magnitude of the overlap integral in band systems where Δr_e is either very small (< 0.01 Å) or very large (> 0.3 Å). Thirteen band systems are examined with Δr_e ranging from zero to 0.4 Å. It is shown that the location of strong bands in the v′v″ plane can be predicted with reasonable accuracy without the computation of Franck-Condon factors. Author

N65-26055# Little (Arthur D.), Inc., Cambridge, Mass.
RADIATION ACTIVATION OF PARA-ORTHO HYDROGEN CATALYSTS Quarterly Progress Report, Jun.–Aug. 1964
Amos J. Leffler [1964] 21 p refs
(Contract AF 33(615)-1362)
(QRP-3; AD-460986)

The effect of various preparative variables on two catalysts was studied. The results indicate that neutron irradiation causes a large increase in catalytic activity which decays to the unirradiated value after a relatively short time. A discussion is given of the effect of neutron irradiation on a catalyst and the possible reason for the decay in activity. Author

N65-26117# California Univ., Los Angeles. Dept. of Chemistry
THE GLASS TRANSITION AND RATES OF CRYSTALLIZATION OF AMORPHOUS $ZnCl_2$
A. Eisenberg and B. J. Hileman 15 Jun. 1964 12 p refs
(Contract Nonr-233(87))
(TR-3; AD-601840)

In a study of the physical properties of amorphous zinc chloride, the determination of the glass transition temperature and rate of crystallization in a reasonable range above glass transition temperature is discussed. A dilatometric method and a technique which measured the linear expansion coefficient were used in determining the glass transition temperature. All determinations of the rate of crystallization were performed dilatometrically. The results are presented. N.E.A.

N65-26132# Tracor, Inc., Austin, Tex.
ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 8 (Summary Report), 1 Jan.–31 Dec. 1964
Larry G. Spears, Larry D. Fiel, Wallace E. Harrell, Jr., and Margaret H. Northrup 7 Apr. 1965 90 p refs
(Contract Nonr-4054(00); ARPA Order 399)
(TRACOR-65-172-U; AD-614098)

This report summarizes the research carried out during the period January through December 1964. Work during the last quarter is emphasized. The goal of this work is to determine the mechanism by which electrochemical fluorination of ammonium and hydrazinium salts occur in anhydrous hydrogen fluoride (AHF). A major portion of the work to date has been done to (1) develop a suitable reference electrode, (2) construct an HF handling system for preparing and maintaining AHF at low electrical conductivities (i.e., $10^{-5}\ \Omega^{-1}\ cm^{-1}$), and (3) select a suitable working electrode. The Hg/Hg_2F_2 electrode satisfies the requirements for a reference electrode, and Monel (alloy 400) satisfies the requirements for a working electrode. Monel is now being used as an anode and Hg/Hg_2F_2 as a reference electrode in studying the electrolysis of NH_4F in AHF Author

N65-26140# Army Chemical Center, Edgewood, Md. Chemical Research Div.
SYNTHESIS OF 7-METHYL-2-OXO-2,4,5,6-TETRAHYDROPYRROLO[1,2-c]PYRIMIDINE
Ray R. Irino Nov. 1964 14 p
(CRDLR-3238; AD-612474)

As part of a study for the elucidation of the structure of saxitoxin, the synthesis was undertaken of a possible C_8 fragment resulting from the degradation of the natural product. The preparation of 7-methyl-2-oxo-2,4,5,6-tetrahydropyrrolo[1,2-c]-pyrimidine, a new ring system, is described. It was concluded that: (1) The selective oxidation to the desired 7-methyl-2-oxo-2,4,5,6-tetrahydropyrrolo-[1,2-c]pyrimidine was accomplished with a dilute neutral aqueous solution of potassium permanganate at room temperature overnight. (2) The physical and analytical properties of 7-methyl-2-oxo-2,4,5,6-tetrahydropyrrolo-[1,2-c]pyrimidine were not identical with those of the product obtained from the natural product. (3) The 8-methyl derivative is the correct structure of one of the degradation products of saxitoxin. Author

N65-26172# Linden Labs., Inc., State College, Pa.
CHEMICAL STRENGTHENING OF CERAMIC MATERIALS Summary Report, 7 Apr. 1964–6 Apr. 1965

Henry P. Kirchner and Robert M. Gruver 7 May 1965 78 p refs
(Contract NOw-64-0381-c)
(AD-463287)

An investigation of the effect of compressive surface layers on the strength of polycrystalline ceramic bodies is described. The feasibility of chemically strengthening poly-crystalline ceramic by formation of low-expansion, solid-solution surface layers has been established. During cooling after sintering at high temperatures, the main body tends to contract more than the surface layers resulting in compressive stresses in the surfaces. The existence of these stresses has been demonstrated by ring tests. Failure by shearing off of the surface layers is prevented by establishing gradual variations in composition within the body. These variations in compositions result in variations in thermal expansion coefficient which, in turn, result in gradual variations in stresses and reduction of the maximum shear stress. The compressive stresses may be acting to reduce the contribution of surface flaws to the structural failure of these bodies. The feasibility of chemical strengthening was demonstrated by forming low-expansion surface layers on TiO_2 and Al_2O_3 bodies and by measuring the strengths of these composite bodies. Substantial increases in the average strengths were observed and the differences in the averages between the treated samples and the controls were found to be significant in the statistical sense. The thermal expansion properties of a wide variety of oxide solid solution compositions in phases having the spinel, periclase and corundum structures were measured. Some of these materials have lower thermal expansion coefficients than the bodies on which they would be placed.
Author

N65-26203 Sulzer Brothers, Ltd., Winterthur (Switzerland).
RECTIFICATION AS A SPECIAL CASE OF THE THEORY OF ISOTOPE SEPARATION
M. Huber *In its* Sulzer Tech. Rev., Vol. 44, No. 1, 1962 p 29–35 refs (See N65-26202 15-15)

For calculating data from rectification columns, an analytical method of determining isotope separation is discussed. General procedures for measuring the desired separation are described, the rectification and cascade theories are presented in detail, and applicable formulas are given. A system of equations is presented so that the cascade theory can be applied directly to make a simple, rough calculation of a separation process and, if the separation is to be carried out in a column, to determine if it is worthwhile to divide the column into two or more stages of different cross section. The division into columns more closely results in the ideal cascade, which can usually enrich a substance from less than 10% to more than 95%. This was shown for D_2O, $(\epsilon = -0/04)$ from X_F to $X_E = 0.998$.
M.W.R.

N65-26248# AeroChem Research Labs., Inc., Princeton, N. J.
EFFECTS OF CONVECTIVE DIFFUSION ON THE APPARENT KINETICS OF ZEROTH ORDER SURFACE-CATALYSED CHEMICAL REACTIONS
Daniel E. Rosner Aug. 1964 44 p refs
(Contract AF 49(638)-1138)
(TP-102; AD-461000)

The apparent kinetics of zeroth order surface-catalysed reactions are quantitatively investigated for several configurations involving laminar or turbulent boundary layer flow, with or without pressure gradient. Nine cases of interest are solved exactly in terms of the incomplete beta function and analytical and graphical results are presented and compared with the results of applying the familiar quasi-stationary approximation. The latter method, which is equivalent to the use of the concept of "local resistance additivity," is shown to fail badly in this chemical kinetic extreme. Applications of the theory to the interpretation of kinetic data and the design of catalytic heat exchangers are discussed.
Author

N65-26271# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut für Raketentreibstoffe
INVESTIGATIONS ON THE SYSTEM LITHIUM–LIQUID AMMONIA [UNTERSUCHUNGEN AM SYSTEM LITHIUM–AMMONIAK]
R. E. Lo Feb. 1965 55 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-05; DVL-384) Available from Zentralstelle fur Luftfahrtdokumentation und inform. (ZLDI), Munich 12,80 DM

In the course of a research program on the system Li–NH_3, which is of interest as a potential rocket-fuel, the following properties have been studied: 1. Solubility of Li in liquid NH_3 as a function of temperature. 2. Vapor-pressures of the solutions as functions of concentration and temperature. 3. Their densities as functions of concentration and temperature. 4. Stability and certain corrosion properties of saturated solutions. 5. Velocity of hydrogen formation according to $2Li + 2NH_3 = 2LiNH_2 + H_2$ as function of temperature.
Author

N65-26288# Lockheed Missiles and Space Co., Sunnyvale, Calif.
BASIC STUDY OF GAS-SOLID INTERACTIONS. I: INTERACTION OF HYDROGEN WITH PLATINIZED CARBON
Andrew J. Robell 2 Mar. 1964 117 p refs
(LMSC-6-74-64-6; AD-614041)

It has been confirmed that the dispersion of platinum on the surface of Spheron-6 carbon increases the adsorption of hydrogen, both in rate and in amount. This excess adsorption, which is too great to be accounted for by the platinum alone, has been measured at 300 to 392° C, at pressures from 30 to 60 cm Hg, and at Pt contents of 0.2 percent and 1.0 percent by weight. The observed dependence of the excess adsorption on these variables and the results of deuterium adsorptions point to a mechanism pictured as follows: Hydrogen adsorbs and dissociates quickly on the Pt. Around the Pt a zone is established which is in equilibrium with the gas phase. This zone acts as a source for surface diffusion of H atoms along the carbon surface. Alternate mechanisms are discussed and rejected. The proposed model is described quantitatively and adequate agreement is obtained with experiment. Within the framework of the model, the activation energy for surface diffusion is 39.2 kcal/g-atom H, and the surface diffusion coefficient at 392° C is 5.77×10^{-17} cm^2/sec.
Author

N65-26290# Naval Research Lab., Washington, D. C. Chemistry Div.
REDUCTION OF POLYMERIC FRICTION BY MINOR CONCENTRATIONS OF PARTIALLY FLUORINATED COMPOUNDS
R. C. Bowers, N. L. Jarvis, and W. A. Zisman 1 Mar. 1965 19 p refs
(NRL-6227; AD-614059) CFSTI: $0.50

A new approach to the reduction of boundary friction in solid polymers has been studied. Dry frictional properties of several classes of polymeric solids have been reduced significantly by the addition of small proportions of a suitably designed surface-active compound. Appropriate fluorocarbon derivatives have been prepared and found effective in polymethyl methacrylate, polyvinyl chloride, and in several polyvinylidene chloride copolymers. These addition agents are effective both in polymer films prepared by evaporation from a solvent and in thick disks prepared from the melt. The low-energy surfaces formed by the fluorinated additives may also

be self-healing, that is, any surface-active molecule lost from the film may be replaced by the diffusion of additional material to the interface. The decrease in friction caused by the addition agent is accompanied by an increase in the equilibrium contact angle of each of several liquids on the polymer surface. The small proportion of addition agent used causes only a small decrease in the hardness of the polymers. There are many promising applications of this technique to specific problems in lubrication and adhesion. Author

N65-26292# Space-General Corp., El Monte, Calif. Chemical and Biological Div.

B_9H_{15} AND B_8H_{12}: SYNTHESIS, EQUILIBRIA AND DECOMPOSITION KINETICS

Robert E. Williams, John Spielman, and J. F. Ditter 15 Mar. 1965 31 p refs Presented at the 148th Am. Chem. Soc. Meeting, Chicago, 1964

(Contracts Nonr-4381(00); Nonr 3364(00); AF 04(611)-5156) (TR-6; AD-612605)

The prevalence of hydrogen tautomerism and skeletal rearrangements in the boron hydrides suggests that either the elimination or accretion of neutral BH_3 groups should take place with ease; hence, it would be expected that boron hydrides observed under rigorous conditions should, in most cases, not differ by any number of BH_3 groups. A pursuant experimental investigation of this hypothesis has resulted in the synthesis of B_8H_{12} (from B_9H_{15}), a high yield synthesis of B_9H_{15} and evidence that some of the published data purported to reveal the existence of B_8H_{12-14} and B_7H_{15-17} have been misinterpreted. A rationale of the complexities in the pyrolysis of the boron hydrides is presented. Author

N65-26296# Oak Ridge National Lab., Tenn. Isotopes Div.

REVIEW OF ORNL THERMAL DIFFUSION PROGRAM, JANUARY–DECEMBER 1964

T. A. Butler, W. R. Rathkamp, and H. B. Greene Jun. 1965 26 p refs

(Contract W-7405-ENG-26)

(ORNL-3815) CFSTI: $2.00

This review of the activities of the ORNL Thermal Diffusion Program for 1964 includes column operation, methods of increasing the feasibility of isotope separation of inert gases by thermal diffusion, and product enrichments. The past year's efforts were concentrated on the separation and enrichment of particular isotopes of the inert gases—neon, argon, krypton, and xenon. Chrome-plated columns to minimize heat losses due to radiation from the heaters and conduction through specially designed spacers holding the heating element and preenrichment of feed material were investigated through theoretical developments. Feasibility of these methods was tested and compared to theoretical evaluations by data obtained from actual operating conditions. Author

N65-26307# AeroChem Research Labs., Inc., Princeton, N. J.

OXIDATION KINETICS OF GRAPHITE AT SURFACE TEMPERATURES ABOVE 1000°K

Daniel E. Rosner and H. Donald Allendorf Jan. 1965 10 p refs Submitted for Publication

(Contracts AF 49(638)-1138; AF 49(638)-1195)

(AD-461535)

Discussed are several aspects of high temperature kinetics of the pyrolytic graphite oxidation, and the effects of diffusional limitations on the apparent kinetics of such highly exothermic heterogeneous chemical reactions. Experiments on the attack of graphite by atomic oxygen in the surface temperature range 1100° to 2000° K revealed O-atom strikes as more effective than O_2 in removing carbon atoms from the lattice. The transition from chemical to transport control for temperature sensitive surface reactions, such as graphite oxidation, indicates that the observed activation energy, reaction order, and sensitivity to flow velocity changes need not lie between the reaction rate and diffusion control. The failure of resistance additivity for the ablation of graphite in air is explained by the effect of the interfacial mass flux during the oxidation process on the local boundary layer profile. G.G.

N65-26317# Texas Instruments, Inc., Dallas. Semiconductor Exploration Lab.

ORGANIC MATERIALS FOR ELECTRONIC APPLICATIONS First Quarterly Progress Report, 17 Jan.–17 Apr. 1964

Rowland E. Johnson and R. C. Sangster [1964] 20 p refs

(Contract AF 33(615)-1364)

(TI-08-64-64; AD-460926)

An extension of the dc glow discharge method has been used to prepare thin polymeric films of naphthalene, anthracene, chlorobenzene, dichlorobenzene and a number of other organic compounds. The infrared absorption was used to characterize the films. The films have been deposited with electrodes and the ultraviolet photoresponse measured. Further evaluation will be made in a photoelectret configuration. Metal chelate polymers of squaric acid, 1,2 diketocyclobutenediol, have been prepared with copper, nickel, and iron. The polymer powders have been pressed into slugs and evaluated. The resistivity is about 108 ohm cm. The polymers are slightly photosensitive and have a thermal activation energy of electrical conductivity of 0.6 – 1.0 eV, partly dependent on the conditions under which the slugs are formed. Author

N65-26329# Solar, San Diego, Calif.

DEVELOPMENT OF PROTECTIVE COATINGS FOR TANTALUM BASE ALLOYS Quarterly Progress Report No. 5, 1 Jun.–31 Aug. 1964

A. R. Stetson 10 Sep 1964 45 p refs

(Contract AF 33(657)-11259)

(RDR-1360-5; AD-461541)

The observation that the 1000 cps electrical conductivity of HfO_2 is independent of oxygen partial pressure was taken as evidence that the conduction process is essentially ionic. Experimental difficulties prevented obtaining sufficient low-frequency conductivity data to allow effective extrapolation to zero frequency. At 2200° C, hafnia appears to be compatible with hafnium, but layers of hafnium less than 1 mil in thickness rapidly (in less than one minute) become essentially saturated with oxygen. Construction has been initiated on an apparatus to be used in continuously recording the change of weight in samples of hafnium and hafnium-base alloys being oxidized under controlled conditions of temperature and reduced pressure. Author

N65-26330# Union Carbide Corp., Lawrenceburg, Tenn. Carbon Products Div.

IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE Quarterly Progress Report, 1 Nov. 1963–31 Jan. 1964

Wright-Patterson AFB, Ohio, AF Mater Lab., 15 Feb. 1964 112 p refs

(Contract AF 33(657)-11171)

(AD-460880)

Differential thermal analysis (DTA) studies on substituted high molecular weight aromatic compounds show that the oxygen-substituted compounds have high reactivity, while nitrogen-substituted compounds have low reactivity. Further electron spin resonance (ESR) studies on the hexamethylbenzene radical in various solvents have clarified the free radical processes involved. Nuclear magnetic resonance (NMR)

studies on a number of methylated polynuclear aromatic compounds have shown methyl proton shifts having excellent correlation with calculated ring proton screening constants. Two methods of producing cokes with high isotropic thermal expansion characteristics are reported. A carbon-black seeding process results in graphite billets with different physical properties than the air-blowing process with the same thermal expansion characteristics. The two methods are being investigated for commercial manufacture in the pilot coker. Contributions of the various refractory oxides in coating performance of the graphite-base refractory composites are discussed. The stability of some refractory oxides in the presence of carbon at high temperatures is shown. Results of field evaluation of materials are given. Author

N65-26338# Princeton Univ., N. J. Plasma Physics Lab.
DECOMPOSITION OF MOLTEN LITHIUM NITRATE BY RADIATION
M. D. Kostin, R. C. Axtmann, and E. F. Johnson May 1965 18 p refs
(Contract AT(30-1)-1238)
(MATT-329)

High energy neutrons produced by fusion reactions in proposed thermonuclear power reactors collide with nuclei of the surrounding coolant-breeder material. The transfer of kinetic energy from neutrons to nuclei which produces rapidly moving ions and atoms, and the subsequent atom-atom collisions which increase the number of energetic atoms are investigated, and an estimate of the total number of energetic atoms produced by a single fusion neutron moving in lithium nitrate is obtained. Approximate kinetic equations describing thermal and radiolytic decomposition are solved for conditions of continuous and intermittent irradiation. For anticipated operating conditions the steady-state concentrations are found to be appreciably different from those at equilibrium in the absence of irradiation. It is also shown that the energy distribution of atoms in the epithermal region is considerably different from the equilibrium Maxwellian distribution. Author

N65-26353# Nuklear-Chemie und -Metallurgie, G.m.b.H., Wolfgang bei Hanau (West Germany).
DEVELOPMENT OF A PROCESS FOR THE PREPARATION OF URANIUM CARBIDES AND CERMETS ON UC-BASIS [ENTWICKLUNG VON VERFAHREN ZUR HERSTELLUNG VON URANKARBIDEN SOWIE CERMETS AUF UC-BASIS]
P. Himmelstein, H. Kroll, H. Kühn, B. Liebmann, and L. Schafer Brussels, EURATOM, Jan. 1965 55 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-088-62-7 RDD)
(EUR-2004.d; EURAEC-1148) Available from Belg. A,. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.
Using the reaction formula:

$$UO_{2+x} + (3+x+y)C \rightarrow UC_{1+y} + (2+x)CO \quad (x \geq 0)$$

pellets uranium carbide of varying carbon contents were made in a induction furnace, with a yield of about 3 kg/hour. The melting and casting of these pellets into compact UC shapes using the skull-melting method was carried out in three different types of furnace. 1. A centrifugal furnace (SMO I) with graphite crucibles of different shapes allowed to prepare rods of low diameter without difficulty. If thicker rods over 27 mm in diameter were cast, cracks appeared and even pipes. The method is suitable for fabrication of samples and small-scale production. 2. To obviate these difficulties, experiments were carried out in a tilting furnace (SMO II). By slowly tilting the water cooled copper crucible, it was possible to cast long pipe-free rods. To avoid surface defects, the moulds must be pre-heated to about 1000° C. 3. For the production of several tons order, a semi-continuous furnace (SMO III) with preheated mounds, was constructed outside the framework of this contract. A suitable shaping of the water-cooled cruicible, including insulations between the rims and the bottom has been founc necessary to control the current distribution. The UC samples with carbon content between 3 and 9 m/o fabricated for property test were made into weld defined cylinders. Besides chemical analysis, density determinations and corrosion tests, metallographic examinations, impact strength and hot hardness measurements were carried out. The results of thermal expansion, heat conductivity and electrical conductivity are within the range of published data. Author

N65-26354# Oak Ridge National Lab., Tenn. Chemical Technology Div.
ENGINEERING DEVELOPMENT OF A FOAM COLUMN FOR COUNTERCURRENT SURFACE-LIQUID EXTRACTION OF SURFACE-ACTIVE SOLUTES
P. H. Haas (Ph.D. Thesis) Jun. 1965 230 p refs
(Contract W-7405-ENG-26)
(ORNL-3527) CFSTI: $6.00

Engineering problems were solved and methods developed for the design and operation of countercurrent liquid-foam columns. The physical chemistry and physical characteristics of foams are reviewed, and analytical and mathematical studies are presented and applied to correlate experimental results. Columns were operated to measure contacting efficiency, foam densities, foam drainage, and foam condensation. The experimental results agree with a model for countercurrent liquid-foam flow based on capillary flow through the Plateau borders between foam bubbles. Data for the drainage of the liquid from the foam flowing vertically or horizontally also agree with the model. Foams were condensed by means of orifices, air-operated sonic whistles, screen-lined centrifugal foam breakers, or cyclones. The removal of radioactive strontium to decontaminate low-level waste was shown to be practical if preceded by a precipitation step to decrease the calcium and magnesium concentrations. R.N.A.

N65-26355# Joint Publications Research Service, Washington, D. C.
RADIOACTIVE ISOTOPE PRODUCTION DEVELOPMENT AT THE BORIS KIDRIC INSTITUTE IN VINCA
Rade Draskovic (Boris Kidric Inst., Vinca, Yugoslavia) 23 Jun. 1965 11 p refs Transl. into ENGLISH from Tehnika (Belgrade), no. 4, Apr. 1965 p 650–652
(JPRS-30769; TT-65-31325) CFSTI: $1.00

The production of radioactive isotopes in Yugoslavia is traced from its beginning in 1957 up to current achievements. Of interest is the production of ^{131}I, ^{65}Zn, ^{64}Cu, ^{51}Cr, and also ^{35}S, and ^{32}P through carrier-less process. Tables list the various radioactive isotopes produced, and the users of the produced isotopes. G.G.

N65-26362# Little (Arthur D.) Inc., Cambridge, Mass.
RADIATION ACTIVATION OF PARA-ORTHO HYDROGEN CATALYSTS Technical Report, Nov. 22, 1963–Dec. 22, 1964
Amos J. Leffler Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1965 75 p refs
(Contract AF 33(615)-1362)
(AFAPL-TR-65-9; AD-462518)

An investigation was carried out to determine whether radiation would increase the activity of para-ortho hydrogen catalysts. The effect of preparative variables and neutron radiation on the activity of iron, chromium, and nickel oxides deposited on a boric acid or sodium tetraborate sublayer all on an alumina carrier was studied at 77° K. In most cases, catalytic activity increased temporarily, but decayed rapidly toward the activity of the unreacted material. It is concluded that the relatively low activity of the catalyst systems at 77° K, as compared with earlier results at 195° K, is due to the strong adsorption of hydrogen that effectively blocks the catalyst sites. The

possibility of reactivating catalysts in situ was investigated. It was determined that neither the introduction of alpha emitters into the catalyst chamber nor the use of ultrasonic energy is an effective reactivation method. During this work, a new theory of the magnetic mechanism of para-ortho hydrogen conversion was developed. Also, gas chromatography was found to be a convenient method for measuring effective diffusivities of catalysts. Author

N65-26373# Polytechnic Inst. of Brooklyn, N. Y.
MECHANISM OF ENZYME ACTION First Semiannual Contractors's Report, Apr. 1–Oct. 1, 1964
C. G. Overberger, T. St. Pierre, J. Lee, C. Yaroslavsky, N. Spassky et al 1 Oct. 1964 39 p
(Contract DA-18-035-AMC-121(A))
(AD-461414)

The activation energy of the esterolytic catalysis of the homopolymers of 4(5)-vinylimidazole and 5(6)-vinylbenzimidazole was determined, and found to be appreciably smaller than that of the corresponding monomers. The entropy of activation for the polymers is also lower than for the monomers. These results indicate the existence of strong cooperative effects of imidazole groups on the polymer chain during the act of catalysis. These interactions are the main reason for the enhanced catalytic action of the polymers. We proceed to look after such effects in imidazole-containing copolymers. A successful synthesis of p-hydroxystyrene is being described. Copolymers of 4(5)-vinylimidazole with p-hydroxystyrene, p-acetoxystyrene and vinyl acetate have been prepared. Quarterization studies are now in progress. The copolymers of 4(5)-vinylimidazole with p-hydroxystyrene, p-acetoxystyrene and vinyl acetate have been prepared. Quarterization studies are now in progress. The copolymers of 4(5)-vinylimidazole with vinylthiolacetate, methoxymethyl vinylsulfide and S-vinyl-O-t-butyl thiocarbonate have been prepared. Water hydrolysis of the first type of copolymers led to the most successful results, while acid hydrolysis and thermal pyrolysis respectively were found satisfactory for the other copolymers. The catalytic rate constants for esterolytic action of the 1:0.3 copolymer of 4(5)-vinylimidazole and vinyl mercaptan were larger than for limidazole at the pH values studied. Cooperative effects are now being discerned from the combined contributions of the imidazole and mercaptan groups. Attempts to prepare optically active catalysts containing the imidazole groups are discussed. The successful preparation of oligomers of 4(5)-vinylimidazole and dimers of benzimidazole with varying polymethylene chains is described. Author

N65-26395 Joint Publications Research Service, Washington, D. C.
NEW SCINTILLATION MATERIALS FOR DOSIMETRY OF ROENTGEN AND GAMMA-RADIATION
S. P. Vershinina, A. V. Chernobay, G. P. Zaplesnichenko, L. N. Kolesnikov, Zh. V. Skuratovskaya et al *In its* Roentgenol. and Radiol. in Ind. and Med., 15 Jun. 1965 p 28–30 refs (See N65-26391 15-04) CFSTI: $2.00

The development of several new scintillation materials for use in the dosimetry of roentgen and gamma-radiation is reported. To eliminate inherent problems associated with the absorption of gamma-radiation by substances having low atomic numbers such as air, organic and inorganic scintillators were combined and heavy substances as fillers were introduced into scintillating plastics to produce mixtures whose relative effectiveness depended only weakly on the energy of impinging radiation. Presented are data on the dosimetric properties of several combination detectors consisting of a scintillating plastic with additives of silver-activated zinc sulfide, thallium-activated potassium iodide, thallium-activated cesium iodide, potassium bromide, sodium chloride, potassium chloride, tetraphenyl-lead, and tetraphenyl-tin. These combination scintillation detectors can be used in the dosimetry of gamma-radiation in the 0.03 to 3 MeV range. S.C.W.

N65-26427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADVANCES IN BIOLOGICAL CHEMISTRY
4 Aug. 1964 499 p refs Transl. into ENGLISH from Usp. Biol. Khim. (Moscow), v. 4, 1962 p 3–261
(FTD-TT-63-1083/1 + 2)

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N65-26434# New York Univ., N. Y. Dept. of Aeronautics and Astronautics
LAMINAR BOUNDARY LAYERS WITH CHEMICAL REACTIONS. PART I: ANALYSIS Interim Report
Herbert Fox Feb. 1965 29 p refs
(Contract DA-31-124-ARO-D-259)
(NYU-AA-65-3; AROD-5020-1; AD-462698)

There is pesented a complete discussion of the chemically reacting laminar layer; there is considered the problem of simultaneous gas phase and wall reaction. The basic solutions, under conditions of unit transport properties, i.e., mass density-viscosity product constant, Prandtl number and Schmidt unity, are derived using previously devised operator techniques. For gas phase reaction the solution for the species distribution is seen to reduce to an integral equation; the temperature arising by quadrature. It is shown that simple first order results for chemistry of the usual complexity occurring in the hypersonic boundary flow can be obtained without resort to large scale computation. The flows over a catalytic wall are derived from unit solutions to the basic problem. Thus the combined problems of finite rate chemistry and finite catalysis are considered. Author

N65-26440# Harshaw Chemical Co., Cleveland, Ohio. Central Research Lab.
INVESTIGATION OF THE EXISTENCE OF OXYANIONS OF FLUORINE AND NITROGEN AND THE NITROGEN–FLUORINE CATIONS Quarterly Technical Summary Report, 28 Jan.–28 Apr. 1965
Gerald L. Hurst and S. I. Khayat 28 May 1965 18 p refs
(Contract DA-31-124-ARO(D)-76; ARPA Order-402)
(HQ-76-9; AD-464144)

Reactions of N_2F_4 with anhydrous metal halides, and the preparation and properties of trans- and cis-N_2F_2 are detailed. It was found that the N_2F_4 is reduced to N by both NaI and CaI_2, without the formation of any N_2F_2. Improvements in the synthesis of the trans-N_2F_2 from N_2F_4 and $AlCl_3$ provide a method for preparing 50 to 60 mole quantities of the diazine. Trans-N_2F_2 undergoes catalytic isomerization in stainless steel at 70° to 90° C, and, under equilibrium conditions at 74° C, the difluorodiazine consists of the cis- and trans-isomers in the approximate ratio of 10:1. The cis-N_2F_2 undergoes thermal decomposition at 74° C. The recommended reaction conditions at this temperature are pressure of $\leq$ 1 atm and reaction time of 1.5+ hr. This yields approximately 90% cis-isomer and a total N_2F_2 recovery of 98%. It is recommended that cis-N_2F_2 which is to be stored for long periods of time be kept in stainless steel or quartz containers at low pressure, and that the containers be kept as cool as possible to avoid formation of the trans-isomer. Extreme caution is urged in the handling of the cis-N_2F_2 or the isomeric mixture, since the condensation of these materials in the presence of water frequently leads to detonations. M.W.R.

N65-26478 Oak Ridge National Lab., Tenn.
INFRARED SPECTRAL STUDY OF SECOND-ORDER TRANSITIONS IN CF_4
R. G. Steinhardt (Hollins Coll.), H. W. Morgan, and P. A. Staats *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 14–15 refs (See N65-26475 15-24) CFSTI: $6.00

The infrared spectra of CF_4 in the liquid and solid state were recorded at different temperatures, using a low-temperature liquid cell. Three absorption bands were studied. The ν_4 and $(\nu_4 + \nu_1)$ absorptions exhibited large discontinuous changes in band width at the second-order transition temperature of 76° K, and smaller discontinuous changes upon passing through the melting point. The second-order transition discontinuity occurs over an experimental temperature range of less than 1/2 degree Kelvin. This is the first reported observation of such a transition in the infrared spectrum. The combinational band $(\nu_2 + \nu_4)$ showed virtually no change at either the first or second order transition temperatures. It appears that the absorption by this band is not influenced by the onset of restricted rotational motion in the lattice. E.E.B.

N65-26555# Bologna Univ. (Italy).
RESEARCH INTO THE CHEMICAL BEHAVIOUR OF SURFACES OF SINGLE- AND BI-CRYSTALS UNDER DIFFERENT EXPERIMENTAL CONDITIONS Final Technical Report, 1 Nov. 1964–31 Mar. 1965
Paolo Spinedi Mar. 1965 44 p refs
(Contract DA-91-591-EUC-3202)
(AD-461078)

The several research branches derived from main line of the basis research, chemical behavior of metallic surfaces, are discussed. Experimental procedure, discussion, and results, are presented on some phenomena related to the behavior of hermatite natural crystals heated, under moderate vacuum in an inert or reducing environment. Research on the behavior of single crystals of germanium with known orientation under controlled oxidation is reported. This research was done in an effort to establish the optimal conditions for the appearance of typical oxidation patterns which could be considered the most significative in order to represent the micro- and macro-defective state of the surface. Remarks are given on: the decoration by organic substances in the vapor phase; and some aspects of the electrochemical behavior of zinc tricrystals. N.E.A.

N65-26556# Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary, Jan. 1–Mar. 31, 1965
C. Pupp et al [1965] 19 p refs
(Contract AF 04(611)-9556; ARPA Order 24)
(AD-464136)

During the past quarter, the conductivity studies of liquid oxygen difluoride and of various "solutions" of OF_2 were continued. A number of different materials were mixed with liquid OF_2 at $-196°$ and $-160°$, usually, and an attempt was made to measure the conductivity. In no case was there a measurable difference in the conductivity of the "solution" from that of OF_2 alone. The specific conductivity of OF_2 calculates to be $\leq 1.4 \times 10^{-10}$ ohm^{-1} cm^{-1} and $\leq 5.16 \times 10^{-10}$ ohm^{-1} cm^{-1} at $-196°$ and $-160°$, respectively. Other work consisted of pressure reactions of OF_2 with Lewis acids such as AsF_5 and SbF_5. The products of interest from such reactions are O_2AsF_6 and O_2OsF_8. Author

N65-26569# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
A BIBLIOGRAPHY ON SOLID HYDROGEN CRYSTALLOGRAPHY
John E. Terry 31 Mar. 1965 14 p refs
(RSIC-393; AD-464176)

This annotated bibliography contains references on the crystal structure of solid hydrogen, deuterium and tritium. The literature indicates that most of the research on the subject has been conducted in the Soviet Union and a lesser amount of research has been conducted in Canada, Great Britain, Japan, Israel and the Netherlands. Because the literature shows ambiguities in the research findings, it is apparent that further research is required in order to determine the exact crystal structure of solid hydrogen. Author

N65-26577# Illinois U., Urbana. Noyes Chemical Lab.
SPIN-ECHO NMR STUDIES OF CHEMICAL EXCHANGE. IV. INTRAMOLECULAR EXCHANGE OF A COUPLED AB SYSTEM
Adam Allerhand and H. S. Gutowsky 14 Feb. 1965 37 p refs
Submitted for Publication
(Contract Nonr-1834(13))
(TR-81; AD-612486)

A mathematical and experimental study of the spin echo amplitudes in a Carr–Purcell train of echoes is reported for a coupled AB system undergoing intramolecular exchange. The density matrix approach was used to derive a set of four coupled recursion relations for the amplitudes of successive echoes. It seems unlikely that the set of equations can be reduced to a simple analytical function applicable to the general case, so a program was written to investigate the properties of the system numerically with a high speed computer. Such an analysis predicts that when the exchange rate $1/2\tau$ is small compared with the coupling constant A in rad sec^{-1}, the amplitude of the echo train is modulated. The modulation frequency depends on A, $1/2\tau$, and on the chemical shift $\delta\omega$ and the rf pulse separation t_{cp}. The modulation diminishes as the exchange rate increases, and it disappears when $1/2\tau \geq 3$. In the latter case, the train of echoes decays exponentially with an apparent decay constant $1/T_2$ which is described by

the semi-classical equations derived previously for the uncoupled AB system. These predictions have been verified by ^{19}F spin echo experiments at 16.70 and 25.27 Mc/sec on 1,1-difluorocyclohexane. Author

N65-26586# Atomics International, Canoga Park, Calif.
OXIDATION–REDUCTION REPROCESSING OF URANIUM CARBIDE REACTOR FUEL. II. BEHAVIOR OF PLUTONIUM AND FISSION PRODUCTS
W. G. Smiley 15 Jun. 1965 36 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10738) CFSTI: $2.00

Experimental data and calculations are presented on the evaporation of plutonium and fission products in the oxidation–reduction pyroprocessing of UC (CARBOX process). The experiments, on the gram scale, included reduction of tracer irradiated UO_2 in a graphite crucible, reduction of a U-Ce-Sm-Nd oxide mixture in a tantalum effusion cell, reduction of a U-Ce oxide in a stream of helium, and arc melting tracer irradiated UC. The results indicate that evaporation of plutonium is controlled by the equilibrium pressure, which is proportional to concentration and at least roughly in agreement with Raoult's law. Cerium behaved similarly to plutonium. Evaporation of neodymium was similar to cerium, but removal of samarium was very much larger. Calculations of the plutonium losses to be expected in typical production-scale operations indicate that the loss in the reduction should not be serious, except possibly by deposition on the crucible walls; this possibility should be investigated further. Losses of plutonium in arc casting UC would almost certainly be substantial, so that this method of refabrication can not be used in any fuel cycle which recycles plutonium. The most promising refabrication method appears to be pressing and sintering. Further work on a larger scale and at higher burnup is recommended. Author

N65-26589# Bureau of Mines, College Park, Md. Metallurgy Research Center
RECOVERY OF TIN FROM HARDHEAD BY FILTRATION
J. A. Ruppert and P. M. Sullivan 1964 17 p refs
(BM-RI-6529)

A study was made of filtration techniques for recovering the major part of the tin contained in iron-tin alloys known as hardhead. Special small-scale filtering apparatus and a three-stage cyclic process were developed. Eighty-seven percent of the tin contained in an alloy of 82 percent tin and 17 percent iron was recovered as pure metal by pressing at 975° C followed by a second pressing at 800° C and a final filtering at 250° C. Small amounts of Sb, Cu, and Fe impurities were removed by adding Al to the molten product and performing another filtration at 250° C. Author

N65-26590# European Atomic Energy Community, Brussels (Belgium).
THE PREPARATION OF SODIUM SAMPLES FOR NEUTRON SCATTERING EXPERIMENTS
V. Verdingh and K. F. Lauer 1965 14 p refs
(EUR-2242.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

A technique is described by which aluminum cans of various shapes can be entirely filled with purified, oxygen-free sodium metal. The method consists of melting and filtration under vacuum of the sodium, followed by canning, gradual cooling and/or extrusion. Author

N65-26591# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE RANGE OF REACTIVITY TRANSFER IN THE RADIOLYSIS OF SOLID HYDROCARBON MIXTURES
P. J. Dyne and J. Denhartog Jun. 1965 9 p refs Presented at the 20th Intern. Congr. on Pure and Appl. Chem., Moscow, Jul. 1965
(AECL-2260) Available from Atomic Energy of Canada, Chalk River: $0.20

Interactions in the radiolysis of hydrocarbon mixtures in which the decomposition of one component is reduced or enhanced by the other component is discussed. This process is called excitation transfer. Experiments are performed to measure directly the range of this transfer—the distance between the donor and the acceptor molecule over which the excitation is transferred. Prepared solid samples were used consisting of thin layers (50 to 1000 Å) of deuterated cyclohexane sandwiched between thick layers of another material (normal hexane, carbon tetrachloride). These thicker layers may enhance or diminish decomposition of the deuterated cyclohexane. The sample was irradiated with Co^{60} gamma rays at 77° K. After irradiation the amount and isotopic composition of the radiolytic hydrogen was determined. The principle of the experiment is presented and the results are analyzed. N.E.A.

N65-26593# Los Alamos Scientific Lab., N. Mex.
ARCHPRO: A COMPUTER PROGRAM FOR THE COMPUTATION OF MOLECULAR WEIGHTS BY THE ARCHIBALD METHOD
G. R. Shepherd, P. N. Dean, and B. J. Noland 8 Jun. 1965 18 p refs
(Contract W-7405-ENG-36)
(LA-3291) CFSTI: $1.00

A computer program (Archpro) has been prepared in Fortran for computation of ultracentrifugal data obtained in the determination of molecular weights by the Archibald method. Author

N65-26608# AeroChem Research Labs., Inc., Princeton, N. J.
MECHANISM OF CHEMILUMINESCENCE OF ATOMIC OXYGEN-HYDROCARBON REACTIONS. FORMATION OF THE VAIDYA HYDROCARBON FLAME BANDS EMITTER
Arthur Fontijn Apr. 1965 27 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(AC-2-P)

The Vaidya hydrocarbon flame bands emitted in the O-C_2H_2 reaction have been investigated in a conventional fast flow system at about 300° K. It is shown that the emitter has as a direct precursor a species which is formed earlier in the reaction than the direct precursors of the other near ultraviolet and visible light emitters and the chemi-ions. Previously suggested mechanisms for formation of the Vaidya band emitter appear incompatible with these and further observations. A reaction between a vibrationally excited $X^3\sum\bar{g}$ CH_2-radical and atomic oxygen leading to CHO^* is postulated to explain the results; plausible alternative reactions are suggested. Author

N65-26609# AeroChem Research Labs., Inc., Princeton, N. J.
MECHANISM OF CN AND NH CHEMILUMINESCENCE IN THE N-O-C^2H^2 AND O-NO-C^2H^2 REACTIONS
Arthur Fontijn May 1965 11 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(AC-3-P)

It is shown that when O-atoms partially replace the N-atoms in the N-C_2H_2 reaction the intensity of the CN- and NH-emission increases several fold. These emissions are also observed in the O-NO-C_2H_2 reactions where they are attributed, at least in part, to N-atoms produced by O-atom abstraction from NO. These phenomena suggest that CN- and NH-emission from rocket exhausts and contaminated re-entry wakes may considerably exceed the intensities expected by neglecting the emitter precursors formed in O-atom hydrocarbon reactions. Author

N65-26613# Columbia Univ., New York. Columbia Radiation Lab.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. THEORY OF ATOMIC BEAM OPTICAL DOUBLE RESONANCE SPECTROSCOPY Special Technical Report
R. Serber and R. Novick 15 Apr. 1965 36 p refs
(Contract DA-28-043-AMC-00099(E))
(AD-464495)

The theory of the atomic beam optical double resonance spectroscopy first introduced by I. I. Rabi is developed. An expression for the transition probability is derived which includes terms that may lead to line shifts and distortions. The approximations made in obtaining this result are given, and means for attaining a more precise line-shape formula are indicated. Author

N65-26640*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANISM OF FORMATION OF CERTAIN METASTABLE PEAKS NOTED ON A CYCLOIDAL FOCUSING MASS SPECTROMETER
Myron O. Davies Washington, NASA, Jun. 1965 9 p refs
(NASA-TM-X-1111) CFSTI: HC $1.00/MF $0.50 CSCL 07B

A previous investigation allowed extended contact between the heated stainless-steel cycloid envelope of the mass spectrometer and gaseous mixtures consisting primarily of hydrogen chloride and water. Because of this contact, roughening of the stainless-steel walls occurred. Backgrounds run with helium showed prominent peaks of definite metastable shape. Similar peaks appeared during procedures for carbiding the tungsten filament. At least eight different metastable peaks were recorded, ranging in mass number from 20 to 260. The metastable peaks are postulated to result from decompositions of iron, chromium, and nickel carbonyls. Author

N65-26651*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISONS OF EXPERIMENTAL HYDROXYL RADICAL PROFILES WITH KINETIC CALCULATIONS IN A SUPERSONIC NOZZLE
Erwin A. Lezberg, Charles M. Rose, and Robert Friedman Washington, NASA, Jun. 1965 28 p refs
(NASA-TN-D-2883) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The hydroxyl mole fraction was determined from spectral line absorption measurements made in a supersonic nozzle that expanded the combustion products of hydrogen and preheated air. Absorption measurements were made as a function of fuel-air equivalence ratio of 0.6 to 1.2 at combustor pressures of 3.6 and 1.8 atm at low supersonic area ratios of 1.6 to 3.55. The measured hydroxyl mole fractions and the previously reported static temperature measurements were then compared to the output of a one-dimensional computer program that included finite rate chemistry. It was concluded that the controlling reaction is

$$H + OH + M \rightleftharpoons H_2O + M$$

Increasing or decreasing the rate of the reaction by a factor of three gave results compatible with the hydroxyl concentration measurements within the uncertainties of the measurement. E.E.B.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-25583# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service
WIRELESS MICROPHONE/HEADSET DEVICE (TELEWALK) Final Report
Clair R. Morris Apr. 1965 28 p
(RD-65-20)

This report contains the results of the development and evaluation of a wireless microphone/headset/channel selection device designed to determine the feasibility of replacing the cord-connected headset presently used. These headsets now used by the air traffic controller and coordinator are physically connected by cords to the operating console or position. The cords limit the mobility of the user and interfere with the operation of the control and display equipment. The system developed used very low-powered radio link equipment to provide communication between the controller and his operating position. The results of the development indicate that a wireless system is feasible and desirable for operator comfort and mobility but it is limited in practicability due to cost and marginal reliability. The development was discontinued due to the fact that the requirement for operator mobility has been decreased in the new concept of air traffic control. Recommendations are made to continue efforts to improve the presently used cord-connected headset and operating position. Author

N65-25677# Columbia Univ., New York. Electronics Research Labs.
ELECTRO-OPTICAL SIGNAL PROCESSING TECHNIQUES FOR PHASED ARRAY ANTENNAS Quarterly Progress Report, 1 Oct.–31 Dec. 1964
M. Arm, A. Aimette, L. Lambert, and N. Wyman [1964] 46 p refs
(Contract AF 49(638)-1478; ARPA Order 279)
(CU-3-65-AF-1478-ERL; P-1/321; AD-613662)

The results of the electro-optical phased array signal processor research program during the past period are presented. The spatially multiplexed system experimental response for a weighted and unweighted aperture distribution is shown graphically and with photographs. The theoretical and experimental system response for a Hamming type aperture weighting function to signals on and off boresight is presented. An experimental sidelobe suppression of 28 db is demonstrated. A Schlieren photograph of the ultrasonic beams within the light modulator is included. The time multipex system signal simulator implementation and block diagram are presented. The method utilized for phase alignment of the simulator is discussed. Author

N65-25683# Lincoln Lab., Mass. Inst. of Tech., Lexington Electronic Systems Div.
COMPUTATIONALLY FEASIBLE FREQUENCY ESTIMATE IN THE PRESENCE OF UNKNOWN PHASE AND AMPLITUDE

L. A. Gardner, Jr. 11 Mar. 1965 75 p refs
(Contract AF 19(628)-500)
(TN-1965-4; AD-613341)

The problem of estimating the angular frequency in a single trigonometric regression function, observed in the presence of correlated noise, can be approached by the method of least squares or by procedures based on the theory of empirical spectral analysis. For real time applications, such methods generally are prohibitively time consuming. Two very simple and consistent frequency estimates, which use at most the first three sample covariances, and derive and compare their large sample distributions, are introduced. One interesting by-product is a precise analysis of the asymptotic behavior of the inconsistent technique known in numerical analysis as Prony's method. Author

N65-25691# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
OPTICAL OBSERVATION OF FAINT SATELLITES Final Report
G. A. Mc Cue, D. F. Bender, J. G. Williams, and A. S. Leonard
Jul. 1964 17 p refs
(Contract AF 19(604)-8427)
(SID-64-1490; ESD-TDR-65-155; AD-613348)

The technical effort for the prediction program, observation reduction and orbital element improvement program, optical characteristics reduction program, western satellite research network teams, and for the direct support of the space detection and tracking system is reviewed. A network of experienced, responsible volunteer observers, which contributes directly to the space detection and tracking system was organized. These visual observers were able to supply the system with observational data (positions and optical signatures) which otherwise would have been unobtainable. E.E.B.

N65-25693# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STUDY OF AN ORBITING DIPOLE BELT COMMUNICATION SYSTEM Technical Report No. 369
F. Belvin and T. J. Goblick, Jr. 22 Dec. 1964 79 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-591; AD-613583)

The design of communication systems utilizing orbiting dipole belts is complicated by the great amount of interaction among the various design parameters involved. A general treatment of the design problem for such systems, necessitating the study of specific examples, is difficult. The simplest example of such a system using a single equatorial dipole belt, was investigated. An altitude of 8000 miles, to provide satisfactory earth coverage, precludes the possibility of a limited orbital lifetime belt. An 800-kg payload of X-band, copper dipoles would provide data rates adequate for certain military needs. Insofar as a specific belt configuration and dipole design were chosen, the specific results of this work do not apply to dipole belt systems in general. The considerations, and approach can be used to design any dipole belt communication system. Author

N65-25702 Joint Publications Research Service, Washington, D. C.
CHANGE IN CORRELATIONAL COUPLING DURING THE SMOOTHING OF DECORRELATED STOCHASTIC PROCESSES
V. I. Chaykovskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 10–22 refs (See N65-25700 15-10) CFSTI: $5.00

It is determined here how the crosscorrelational coefficient of artificially decorrelated stationary random processes depends on their degree of smoothing. It is shown that when decorrelation is realized in a system with a variable transfer ratio, then the subsequent smoothing practically does not alter the correlational coupling while the correlational coupling of processes decorrelated by shift in time is fully restored. Author

N65-25703 Joint Publications Research Service, Washington, D. C.
SEPARATION OF A MARKOVIAN PULSE SEQUENCE FROM NOISE
A. F. Terpugov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 23–30 refs (See N65-25700 05-10) CFSTI: $5.00

An analysis is made here of the optimal receiver for separating a Markovian pulse sequence from additive white Gaussian noise. Author

N65-25704 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF THE PHASE STABILIZATION IN A RESONANCE AMPLIFIER EXCITED BY RADIO-PULSES WITH A RECTANGULAR ENVELOPE
I. D. Zolotarev *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 31–40 refs (See N65-25700 15-10) CFSTI: $5.00

The phase stabilization of an output signal is studied for the case of a resonance amplifier excited by radio-pulses with a rectangular envelope, the initial phase of high-frequency space charge being arbitrary. The phase deviation of the output signal is analyzed as a function of the initial phase at which the excitation signal is switched on; the resonant load of the amplifier has here any arbitrary Q-factor and the detuning is also arbitrary. Conditions are established for which the phase deviation due to transients is minimum. Author

N65-25707 Joint Publications Research Service, Washington, D. C.
ON THE NOISE STABILITY OF A CORRELATION SYSTEM WHEN THE NOISE IS DUE TO CHAOTIC REFLECTIONS
N. M. Malyarevskiy, K. B. Krukovskiy-Sinevich, and V. S. Lazebnyy *In its* VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 58–67 refs (See N65-25700 15-10) CFSTI: $5.00

Problems are analyzed concerning the detection of individual pulses against a background of chaotic reflections in coherent reception. The choice of radiated pulse duration is discussed. Author

N65-25709 Joint Publications Research Service, Washington, D. C.
PASSAGE OF SIGNAL AND NOISE THROUGH A RECEIVER WITH A NON-LINEAR AMPLITUDE CHARACTERISTIC
L. B. Neronskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 76–87 refs (See N65-25700 15-10) CFSTI: $5.00

The simultaneous passage of signal and noise through a receiving device is analyzed here, the latter consisting of a band-pass amplifier with a non-linear amplitude characteristic and a detector (linear detector of the envelope and coherent detector). The mathematical reliability is determined, also the dispersion and amplitude of the harmonic content in the signal, the signal/noise ratio at the output for the cases of a logarithmic amplitude characteristic and of a limiter—with various values of the signal/noise ratio at the input and as functions of the gain. Author

N65-25711 Joint Publications Research Service, Washington, D. C.
EVALUATION OF THE TRANSMITTIVITY OF CERTAIN RADIO CHANNELS WITH VARIABLE PARAMETERS
I. S. Braynina *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 67 1964 3 Jun. 1965 p 101–112 refs (See N65-25700 15-10) CFSTI: $5.00

An analysis is made of the limiting transmittivity of communication channels with slow and smooth fading where the amplitude of the signal at the receiving station is distributed according to the "transformed χ^{2}" law. It is shown that this kind of distribution is a satisfactory approximation of the generalized Rayleigh law. Author

N65-25714 Joint Publications Research Service, Washington, D. C.
CONCERNING THE DIRECTION OF SIGNALS REFLECTED FROM MOVING BODIES
K. V. Krukovskiy-Sinevich and N. M. Malyarevskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 128–130 refs (See N65-25700 15-10) CFSTI: $5.00

The detection characteristics of pulsed signals reflected from moving bodies in the presence of a fluctuating interference were investigated. A system with a coherent detector was examined as the detection system. Results of the work made it possible to introduce the concept of the optimum averaging time of the signals received. With other conditions equal, the increase in the averaging time above the optimum time is accompanied by a reduction in the interference immunity of the system. R.N.A.

N65-25720 Joint Publications Research Service, Washington, D. C.
ON ENERGY VARIATIONAL PROBLEM IN RADIO DETECTION IN A CONTINUOUS ZONE OF SURVEY
G. B. Linkovskiy and V. F. Krapivin *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 160–165 refs (See N65-25700 15-10) CFSTI: $5.00

For the problem of determining the optimum effort to apply in detecting a continuous signal in a bounded continuous radio-frequency spectrum, an approximate solution is presented. A nonuniform density, f(z), is specified for the probability that a signal will occur at point z between the bounds z_1 and z_2. A density, p(E,z), is defined for the probability that a signal will be detected at z with an expenditure of energy, E(z). The product f(z)p(E,z) is formed and integrated over the range on z. The problem then is to find the value of E(z) which minimizes the integral; a modified form of Newton's method is employed, involving successive approximations which converge rapidly to a limiting value for the optimum E(z). The result is illustrated in an example in which both f(z) and p(E,z) are normal distributions. J.M.D.

N65-25737# Harry Diamond Labs., Washington, D. C.
DIELECTRIC-LOADED WAVEGUIDE SLOT ARRAYS
Howard S. Jones, Jr. 22 Jan. 1965 33 p refs
(HDL-TR-1269; AD-612621)

A class of slotted arrays that utilizes the principle of dielectric-loaded waveguide is described. The physical design of these arrays for operation at C-, S-, and L-band frequencies is characterized by their unusually small volume. Design techniques, dielectric material characteristics, and theoretical concepts for practical array-designs are discussed. Simplified methods of construction are outlined, and the performance of each design type is presented. This includes data on design parameters, voltage standing wave ratio, and radiation pattern characteristics. These dielectric-loaded slot arrays offer substantial savings in volume, weight, and overall cost when compared with their conventional counterpart. A typical design (0.125 × 1.20 × 10.5 in) at 5.4 Gc has a gain of 12.0 db, 16-deg elevation beamwidth, sidelobe level below 22 db, and a VSWR less than 1.5 over a 10-percent bandwidth. Author

N65-25742# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EXPERIMENTAL OBSERVATION OF THE CREEPING WAVE PHENOMENON IN BACKSCATTER USING A SHORT PULSE RADAR SYSTEM
D. F. Sedivec and D. E. Foreman (Gen. Dyn., Fort Worth, Tex.) 14 Jan. 1965 24 p refs *Its* Group Rept.-1965-3
(AD-612537)

The short pulse radar return of two bodies was measured to determine the contribution of individual scattering elements to the overall cross section. Evidence is presented which appears to verify the existence of the creeping wave echo, and shows it to be the predominant contribution to the return from these bodies at nose-on incidence. Author

N65-25746# Naval Research Lab., Washington, D. C. Radar Div.
AIRCRAFT ASPECT SOLUTION IN DYNAMIC RADAR AREA MEASUREMENTS
I. D. Olin 10 Feb. 1965 12 p ref
(NRL-6194; AD-613551)

Among the problems in radar cross-section measurement of full-size aircraft in flight is the difficulty associated with correlating the actual measured values with the aircraft aspect angles. Since the only aspect information available from the radar consists of target locations in spherical coordinates, a solution is desired from these data alone. By imposing restrictive conditions on the aircraft flight courses, target-oriented coordinates may be specified. When these are combined with the radar beam position, the desired solution is established. Author

N65-25761# Aerospace Corp., El Segundo, Calif. Guidance Systems Dept.
ON THE EFFECT OF AZIMUTH ON THE ACCURACY OF AN INTERFEROMETER RADAR
C. W. Pittman Feb. 1964 16 p ref
(Contract AF 04(695)-269)
(TOR-269(4182)-7; AD-460973)

Data were analyzed to explain improved injection accuracy over preflight simulation predictions, and to determine why an improvement on the order of a factor of two instead of three resulted when the rate system baselines were extended from 2000 to 6000 feet. If errors in range rates originate from three individual noise sources, or ground stations, the relative accuracy of the system varies with azimuth from 1 to $\sqrt{3}$. Maximum accuracy for azimuth is on the plane bisecting the angle formed by the baselines; maximum accuracy for elevation is on a plane perpendicular to this bisector. In both cases, maximum accuracy occurs when differences in range rates cancel out. Angles of measurement from the central station are primarily functions of range or range rate differences between the stations. Sensitivity of angular rate errors to noise is illustrated with variation attributed to the changing sensitivity of the angular rates to raw measurements at each station rather than changes in azimuth. Also illustrated is the geometry of the system which assumes that the baselines between the stations are equal in length and at right angles to each other. Presented are data related to the cross-correlation of the range rate differences and the sensitivity of the angles of measurement. While the analysis was applied to a rate-measurement system, the results are equally valid for a position-measuring system. An interferometer radar was used. M.W.

N65-25784# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
SIGNAL DESIGN TECHNIQUES. VOLUME V: PERFORMANCE OF EASILY IMPLEMENTED ERROR REDUCTION TECHNIQUES Technical Report, Feb. 1963–Dec. 1964
John C. Hancock and R. G. Marquart Wright-Patterson AFB, Ohio, AF Avionics Lab. Feb. 1965 171 p refs
(Contract AF 33(657)-10709)
(AFAL-TR-65-12, Vol. 5; AD-613070)

Techniques designed to reduce the probability of error in the transmission of digital data were evaluated. Techniques included both coding techniques and reception methods, and were selected on the basis of ease of implementation and expected effectiveness. To measure the effectiveness of an error reduction technique, the quantity "merit" is defined as a measure of the savings in power that can be obtained with an error reduction technique when compared to an untreated system operating at the same performance level. The per-limit error probability at the decoder output, as a function of that at its input, is obtained for three coding techniques; the Hamming SEC, the Wagner code, and the Hamming DED. Merit and applicable required feedback channel capacity are computed. Reception techniques investigated include a null zone system and a newly-postulated time-quantized version of sequential reception or a "pseudo-sequential" system. Author

N65-25790# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
SIGNAL DESIGN TECHNIQUES. VOLUME III: CERTAIN OPTIMUM SIGNALING WAVEFORMS FOR CHANNELS WITH MEMORY Technical Report, Feb. 1963–Dec. 1964
John C. Hancock and H. Schwarzlander Wright-Patterson AFB, Ohio, AF Avionics Lab., Feb. 1965 127 p refs
(Contract AF 33(657)-10709)
(AFAL-TR-65-12, Vol. 3; AD-612910)

Optimum signaling schemes for digital communication over memory channels consisting of a linear system with a rational transfer function followed by an additive white Gaussian noise, are investigated. Assuming binary transmission of equally likely signals and fixed average transmitter power, the probability of received errors in minimized for an arbitrary fixed signaling rate by selection of the best waveshape out of those input signals which yield intersymbol interference-free waveforms at the channel output. An increase in signal alphabet size reduces the error probability. General properties of optimum signals derived include low-pass channels of the Butterworth type which provide a useful basis of comparison because of the simple form of their energy transfer functions. The performance of the optimum signal for a simple RC low-pass channel is compared with the performance of simple rectangular pulses when transmitted through the same channel, showing the degrading effect of intersymbol interference on error rate. A different structuring of the transmission is also considered. Successive signals are made to overlap somewhat at the transmitter and the receiver is postulated to make no observation during the intervals of overlap. Author

N65-25819# Aeronutronic, Newport Beach, Calif.
SPIRAL DECAY AND SENSOR CALIBRATION DIFFERENTIAL CORRECTION PROGRAMS. VOLUME I: PROGRAM DEVELOPMENT
T. G. Gaa, C. G. Hilton, P. A. Vanderstucken, and L. G. Walters Bedford, Mass., AFSC, Electron. Systems Div., 31 Jan. 1965 25 p
(Contract AF 19(628)-3377)
(ESD-TDR-65-76; AD-613279)

Theory, operation, coding details, and experience with a computer program for the accurate prediction of the reentry corridor of an earth satellite undergoing orbital decay due to atmospheric friction is presented. This program is also useful in the precision prediction of satellite positions for other purposes such as sensor calibration and weapon systems. Author

N65-25820# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
SIGNAL DESIGN TECHNIQUES. VOLUME I: A TUTORIAL OVERVIEW OF THE FINAL TECHNICAL REPORT ON CONTRACT AF 33(657)-10709. VOLUME II: LEARNING IN SINGLE AND TWO THRESHOLD DECISION MAKING SYSTEMS
J. C. Hancock, J. C. Lindenlaub, and D. F. Mix Wright-Patterson AFB, Ohio, ASD, Feb. 1965 128 p refs
(Contract AF 33(657)-10709)
(AFAL-TR-65-12, Vol. I, II; AD-612909)

Various areas of the statistical communication theory were studied. Four learning systems, usable in communications or pattern recognition applications, were considered: learning with teacher, and learning without teacher or averaging overall partitions, decision-directed measurements, and the iterative procedure. These systems were applied to single- and two-threshold decision-making models, and performance of the models was investigated by the Monte Carlo methods on the IBM 7094 computer. Probability of error was determined for both models, and new theories to account for both the true parameter value and the estimate are suggested. Experimental results indicate that the best method for learning in a practical situation is the decision-directed measurements technique. It is pointed out that results of the present research are limited to study of the mean of a Gaussian curve. Additional information is needed with regard to the covariance of the Gaussian model as well as for non-Gaussian statistics. M.W.R.

N65-25825# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STATISTICS OF THE RADAR CROSS SECTION OF A VOLUME OF CHAFF
S. L. Borison 10 Feb. 1965 14 p refs *Its* Group Rept.-1965-10
(AD-612887)

The average and standard deviation of the radar cross section of chaff is computed under the assumptions that dipoles are randomly oriented and randomly distributed within a radar resolution volume. For a single type of chaff, the standard deviation approaches the average value as the average number of dipoles increases. When the number of dipoles per resolution volume is small, the statistics of the single dipole cross section are important. The results are then generalized to the case of several types of dipoles distributed in space. The average cross section is simply the sum of the average cross sections for each type; however, the standard deviation involves additional terms which are not small. These terms are just sufficient to again provide the Rayleigh limit $\delta s/\langle s\rangle \to 1$ as the number of dipoles increases. Author

N65-25828# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIGNAL DISTORTION IN A FREQUENCY DIVIDER Technical Note No. 1965-11
J. Max 12 Mar. 1965 55 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-59; AD-614425)

When a narrowband modulated signal excites a frequency division system, such as a chain of flip-flops, the low frequency output of the chain tends to exhibit the same bandwidth as the input signal. When the output of the divider is multiplied back up to the original frequency, the phase modulation of the original signal is recovered, together with distortion components whose magnitude depends on the details of the division

process, in particular, on the percentage bandwidth of the signal at each step. A means for estimating the effective bandwidth of a phase on frequency modulated signal is developed and used to produce quantitative estimates of the signal degradation which results from a frequency division process.

Author

N65-25839# Naval Research Lab., Washington, D. C. Applications Research Div.

SIGNAL-SIMULATOR FOR THE NAVY SPACE SURVEILLANCE SYSTEM COMBINERS Interim Report

H. B. Gardner 10 Feb. 1965 14 p refs

(NRL-6243; AD-612510)

To test the performance of an interferometer phase-channel combiner, the phase of many signals must be varied in a coherent manner. The electromechanical signal-simulator used for combiner research is costly and considered too cumbersome for use in field installations. Consequently, using a basic principle of combiner operations, that of translating the incoming phase carriers to frequencies proportional to the antenna spacing, provides an indirect approach to the simulation of signals. Using a single signal source, a dynamic check of any or all channels may be made rapidly. Author

N65-25840# RAND Corp., Santa Monica, Calif.

A STATISTICAL ANALYSIS OF PHASE ERRORS AND PHASE DIFFERENCE ERRORS DUE TO THE ATMOSPHERE IN THE OBSERVATIONS OF THE RADAR RETURN FROM A SATELLITE

Marvin Blum Apr. 1965 81 p refs Presented at the Spring Meeting of The Intern. Sci. Radio Union, Natl. Acad. of Sci., Washington, D. C., 20–24 Apr. 1965

(Contract AF 04(695)-252)

(P-3115; AD-614414)

A summary of the statistical properties of the ionosphere and troposphere is presented. A mathematical model is developed to compute the phase errors due to the atmosphere. The phase errors are divided into random errors and residual bias errors. The residual bias error is the unknown component of phase error left after theoretical corrections based on measurements during satellite passage of surface index of refraction and ionospheric profile parameters. The total mean square phase difference ($\sigma^2(\phi)$) is computed as the sum of four components. The components are the random and residual bias errors for the troposphere and ionosphere. The $\sigma^2(\phi)$ is presented versus D, the linear distance measured along the track from zenith position at a later time at elevation angle β_0. It is shown that for large values of D such that csc $\beta_0 >> 1$ the residual bias errors are the dominant factors. A table of optimum frequencies f_0 which minimize $\sigma^2(\phi)$ is presented for the typical and extreme conditions of altitude, integrated electron density, and integrated refractivity. Author

N65-25852# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.

TRANSFORMATIONS FOR RADAR AMBIGUITY FUNCTIONS Technical Report No. 82

Edward L. Titlebaum Dec. 1964 123 p refs

(Contract DA-36-039-AMC-00034(E))

(EERL-28; AD-612656)

This investigation sheds new light on the area of radar ambiguity functions and their ability to improve signal design. The problem is approached from two directions. First, a number of signal transformations are presented along with their corresponding ambiguity functions. These include both linear transformations induced by processing the signal through a linear time-variant system and nonlinear transformations generated by functional transformations upon the signal. Three simple linear signal transformations are shown to generate the allowable class of linear transformations of the ambiguity plane for signals that have rational or entire functions as their spectra. Hence, for the class of time-limited signals the complete class is presented. It is proven that nonlinear tranformations of the ambiguity plane are restricted to only unrealistic signals. Second, the ambiguity function is perturbed in a number of ways in an effort to improve some quality of the signal for radar purposes. To this end tests based upon existing theorems are developed to determine the applicability of any particular perturbation. The class of linear transformations of the ambiguity function are presented in two forms: for ambiguity functions given in analytic and in digital form. A major restriction for digital computations is shown. If a signal can be specified by $2K+1$ data points, then in general one requires $(4K+1)^2$ $(2K+1)^2$ points, or approximately $64K^4$, to specify a weighting of the ambiguity grid. It is shown that processing the signal through any linear system generates a weighting of the ambiguity function of this type. Author

N65-25854# Naval Research Lab., Washington, D. C. Sound Div.

THE EFFECTS OF UNEQUAL RADIATION LOADS ON THE UNIDIRECTIONAL PROPERTIES OF A 36-ELEMENT BI-PLANAR ARRAY OF ACOUSTIC PROJECTORS Interim Report

M. A. Blizard 3 Mar. 1965 21 p refs

(NRL-6207; AD-612762)

A mathematical model was derived of a 36-element, bi-planar array of variable-reluctance, two-mass, quasi-dipole, acoustic projectors. It was assumed that mutual interactions and scattering may be neglected and that all projectors in the same plane have the same acoustic load. Various projector element properties and array properties were computed with the aid of an electronic digital computer as a function of frequency and several combinations of acoustic radiation loading and these arbitrary conditions: (1) separation of the two planes, (2) phase angle by which the input voltage of the rear plane leads the input voltage of the front plane, and (3) constant and equal input current magnitudes for the two planes. The projector element properties computed were (1) the radiating surface velocity magnitude, (2) the phase angle by which the radiating surface velocity leads the input voltage, and (3) the input impedance; the array properties computed were (1) the acoustic pressure at a point in front (and in back) of the array, (2) the acoustic power, (3) the directivity index, and (4) the efficiency. The model illustrates the alteration of the unidirectional radiation of the array as a consequence of unequal radiation loads on the two planes. The model also indicates a limited improvement in the unidirectional radiation due to the addition of tuning capacitors in series with the individual projectors. Author

N65-25855# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration

ESTIMATION OF SPECTRAL CHARACTERISTICS FOR A CLASS OF NON-STATIONARY TIME SERIES Final Report

Melvin Hinich Feb. 1965 28 p refs

(Contract Nonr-760(24))

(Rept.-34; AD-612779)

This paper deals with time series which are stationary in the mean but which have a nonstationary convariance function which is described by a certain parametric model. The non-stationarity results from changes over time of the parameters in the model. The first part of this paper discusses the concepts of stationarity, covariance, and the spectrum. The concept of temporal spectrum is introduced and applied to the analysis of the nonstationary time series. The second part deals with

the parametric model. Statistics related to the rate of zero-axis crossings and the rate of relative maxima and minima of the time series are used to estimate the parameters in the model. These estimates are easy to compute for discrete observations of the time series. Expressions for the variances of these estimators are given as a function of the parameters and the sampling period. Author

N65-25858# Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.
DEVELOPMENT OF A LARGE DYNAMIC RANGE TUNNEL DIODE AMPLIFIER FOR PHASED ARRAY RECEIVERS Final Report, 16 Mar.–31 Oct. 1964
A. Presser [1964] 50 p refs Prepared for Lincoln Lab., MIT
(Contract AF 19(628)-500)
(AD-613613)

The objective of this two phase program is to develop large dynamic range S-band tunnel diode amplifiers for phased array receivers. Phase I calls for the development of a prototype amplifier, and phase II for a reproducibility study of amplifiers and an investigation of amplifier characteristics pertinent to phased array applications. This report covers the theoretical and experimental work performed under phase I of the program. The theoretical considerations show that an optimum combination of low noise and large dynamic range can be realized by cascading two amplifiers. The first stage of this amplifier must provide low noise performance, and the second stage large power output. In the experimental amplifiers developed under this program Ge tunnel diodes were used in the first stage and GaAs tunnel diodes in the second stage. These diodes were mounted in special ultra low inductance stripline packages. One two stage tunnel diode amplifier was delivered to Lincoln Laboratories. This amplifier operates at a center frequency of 2.86Gc, has a 1.5db bandwidth of 120Mc, a gain of 17.3db and a noise figure of 5.6db. The amplifier is unconditionally stable and its output power at the 1db gain compression point is −13.7dbm. Author

N65-25864# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MEASUREMENT OF PROPERTIES OF SPREAD CHANNELS BY THE TWO-FREQUENCY METHOD WITH APPLICATION TO RADAR ASTRONOMY Technical Report No. 372
T. Hagfors 11 Jan. 1965 23 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-29; AD-614233)

Measurement of time-varying spread channels having time-stationary Gaussian statistical properties is analyzed. The scheme used works well for both underspread and overspread channels as well as on cases where there is correlation between the signals arriving with different delays. Expressions are derived for the variances of the determined correlation and target-scattering functions derived by double Fourier transformation of the observed correlation function. Author

N65-25887# Hyletronics Corp., Burlington, Mass.
THE DEVELOPMENT OF BROADBAND DIGITAL PHASE SHIFTING NETWORKS USING SEMICONDUCTOR SWITCHES Interim Development Report, 5 Nov. 1964–5 Feb. 1965
2 Mar. 1965 25 p
(Contract NObsr-91300)
(AD-613033)

The initial designs of components required for 4-bit phase shifters were fabricated and tested. The components required in the design of the 4-bit time delay phase shifter were completed and applied to the final assembly. The preparation of the photographic negative of the unit is complete. The real time delay phase shifter will be fabricated and tested during the final period of this program. The components of the phase delay shifter will also be completed and incorporated into a single microwave printed circuit during this period. Author

N65-25890# PEK Labs., Inc., Sunnyvale, Calif.
LASER FLASH LAMP Semiannual Technical Summary Report, 30 Nov. 1963–1 Jun. 1964
C. H. Keller, J. P. Moffatt, and G. O. Harding [1964] 19 p refs
(Contract Nonr-4122(00); Proj. Defender)
(AD-613346)

An optimization study is presented on the development of flash lamps for pumping laser rods. Two approaches are being pursued, one uses an opacity measurement to determine the advantages of doping the spectral output to select wavelengths within the narrow pumping band, and the other is a brute force series of trials in which lamps of sturdier than usual structure are tested to their destructive limit. A variety of flash tube forms are described. One form considered because of its accuracy, consists of a single tube with parallel flat sides from angles 0° to 60° and a metal aperture for light selection. A Claesson-type lamp is described and the results of its destructive testing are tabulated. R.N.A.

N65-25896# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
SIGNAL DESIGN TECHNIQUES. VOLUME IV: DISTRIBUTION-FREE DETECTION PROCEDURES Technical Report, Feb. 1963–Dec. 1964
John C. Hancock and D. G. Lainiotis Wright-Patterson AFB, Ohio, AF Avionics Lab., Feb. 1965 149 p refs
(Contract AF 33(657)-10709)
(AFAL-TR-65-12, Vol. IV; AD-613069)

A class of two-input detection systems for digital communication over random and unknown channels is investigated. The systems possess false-alarm rates which are invariant for wide classes of channel statistics. The only information concerning the channel statistics which is required by these detectors is the median of the noise under no-signal conditions. The coincidence procedures are subsequently modified so that the detectors utilizing them become (1) learning systems with respect to slowly time-varying and/or unknown location parameters or (2) adaptive systems with respect to rapidly varying and/or unknown location parameters. Classes of detection problems for which the false-alarm rates of the above procedures detectors remain distribution-free are obtained. In addition to the distribution-free coincidence detectors, a detector based on the T-statistic and well suited for the detection of stochastic signals in noise, is investigated. The T-statistic is then modified so that the detector utilizing it becomes an adaptive system with respect to rapidly varying and/or unknown location parameters. The wide classes of detection problems for which the above detectors remain distribution-free are obtained. The distribution-free detectors are then applied to various practical detection problems, and their performances are compared to the performances of comparable likelihood detectors. Author

N65-25950# Towson Labs., Inc., Md.
DEVELOPMENT AND FABRICATION OF A PROTOTYPE AIRBORNE AND GROUND ENCODING SYSTEM (U) Final Report
C. Barbour 13 Jan. 1964 28 p
(Contract DA-36-034-ORD-3443(RD))
(AD-426999)

The report describes the development and fabrication of an airborne analog to digital converter and a ground based analog to digital converter. Both units utilize charge transfer circuits to accomplish the conversion of an analog voltage to a train of pulses which represents a digital number. In the airborne

converter, the serial train of pulses is converted into an NRZ format, and this waveform is the digital output. In the ground based converter, the serial train of pulses is fed to a shift register, from which the digital output may be obtained either in serial NRZ or in parallel form. Also, the ground based converter is reversible, which is to say that a serial train of pulses representing a digital number can be converted into an analog voltage in addition to the function of the analog to digital conversion. Author

N65-25955# Bendix Field Engineering Corp., Owings Mills, Md. Electromagnetic Compatibility Engineering Section

VALIDATION MEASUREMENTS ON LOGARITHMIC AMPLIFIER AM-1724A/FPS-7, SERIAL NUMBER 160 Final Report

Griffiss AFB, N. Y., RADC, Mar. 1965 41 p refs
(Contract AF 30(602)-2975)
(RADC-TDR-64-507; AD-613192)

This report describes the Validation Measurements on the Logarithmic Amplifier AM-1724A/FPS-7, Serial No. 160. The task outlined in this report has been performed and the data submitted in accordance with Contract AF30(602)-2975, Task Order No. 7. The validation measurements described in this report present a comparison of logarithmic amplifier characteristics versus normal amplifier characteristics. Three comparison tests are described, each test having been performed under controlled conditions. The three tests are: 1) minimum detectable signal, 2) false alarm time, 3) dynamic range. This report is to be used as an input to the United States Air Force Electromagnetic Compatibility Program. Author

N65-25962# General Atronics Corp., Philadelphia, Pa.

S-3000X PROTOTYPE HF DIGITAL DATA MODEM Final Report

Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 50 p *Its* Rept.-1367-2004-10
(Contract AF 19(628)-3281)
(ESD-TDR-64-679; AD-612634)

The S-3000X Prototype HF Digital Data Modem is a breadboard test model which provides a simulation of 3000 b/s data transmission on a high frequency radio voice circuit while actually transmitting 1200 b/s or 750 b/s. A provision has been made for redundant transmission at lower rates for comparison purposes. This final report covers the system specification, critical subsystem and component specifications, laboratory evaluation, a performance analysis and a reliability analysis of the S-3000 modem. Author

N65-25967# Ground Electronics Engineering-Installation Agency, Griffiss AFB, N. Y.

ANTENNA WIRE SAG AND TENSION CALCULATIONS

T. Prossner Feb. 1965 51 p
(GEEIA-TR-65-1; AD-614075)

The design and construction of horizontal and sloped rhombic antennas for ground communications equipment is reviewed with emphasis on the concept of sag in cables associated with antenna sag, cutting length, and tension under conditions of least loading, additional loading caused by wind and ice, vibration, temperature change, deformation under load, and by prestress. Also discussed is the effect of sag and tension of cables on the supporting towers or poles. It was concluded that all antennas involving the sag of wire should be engineered on an individual basis under consideration of the on-site conditions, weather, materials used, and electronic compatibility. G.G.

N65-25977# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

WAVES GUIDED BY A BOUNDARY WITH TIME-SPACE PERIODIC MODULATION

E. S. Cassedy 22 Jan. 1965 51 p
(Contracts AF 19(604)-7499; AF 19(628)-4324)
(PIBMRI-1251-65; AFCRL-65-116; AD-612965)

We here consider electromagnetic waves guided by a plane surface impedance which is modulated periodically in time and space in the traveling-wave sense. The problem treated is a linearized statement of the nonlinear parametric interaction of waves on an open wave guide structure. In this linear treatment we take the rigorous approach formerly used on (purely spatial) periodic structures. We examine parametric wave interactions of both the stable and the (potentially) unstable type. The regions of operation for bound surface waves, as opposed to (radiating) leaky waves are determined rigorously for this structure. A region of operation called herein the "sonic" region is found which represents a form of an electromagnetic shock wave. This sonic region precludes, for the model chosen, the possibility of traveling-wave amplification along the length of the structure. The above mentioned results are forthcoming only from the complete treatment, including the effects of all time-space harmonics, carried out below. Finally, the power mixing principle for all harmonic waves is determined to be the Manley-Rowe power-frequency relation applied at the boundary surface. Author

N65-25979# Pan American World Airways, Inc., Fort Huachuca, Ariz.

U. S. ARMY RFCP SPECTRUM SIGNATURE PROGRAM Quarterly Progress Report, 1 Nov.–31 Jan. 1965

[1965] 35 p
(Contract DA-02-086-AMC-0032(R))
(QR-5; AD-612926)

Radio and radar spectrum signature measurements made on transmitters are discussed. Spurious emissions were monitored on a spectrum analyzer which facilitated simultaneous display of the fundamental and harmonic frequencies. A comparison of the harmonic content of transmitter emission power levels indicated a definite correlation between the terminating load and the radiated amplitude of harmonics. An investigation of the amount of change in harmonic amplitude as a result of antenna environment for a fixed antenna showed that for any given transmitter and antenna configuration, the harmonic amplitude could be predicted. J.M.D

N65-25990# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration

A TWO-STAGE LIKELIHOOD-RATIO DETECTION PROCEDURE FOR AN UNKNOWN WAVEFORM WHICH IS RANDOMLY REPEATING IN NOISE Management Sciences Report No. 35

Melvin Hinich Feb. 1965 27 p refs
(Contract Nonr-760(24))
(AD-613078)

Suppose we have a stochastic process which is made up of an unknown waveform θ of finite duration, which is repeated randomly in Gaussian noise with a known covariance function. The rate of recurrence of the waveform is a known constant and the signal-to-noise ratio of the waveform in the noise is small. A two-stage procedure is developed for detecting the epochs of θ based upon efficient large-sample estimates of the autocorrelation ψ of the waveform. The error probabilities are given for this procedure which is based upon approximation of the likelihood-ratio. A bound for the error due to the approximation of the likelihood function, is given. Author

N65-25994# RAND Corp., Santa Monica, Calif.
SUFFICIENCY AND INFORMATION RATE OF MULTI-STAGE STATISTICAL TESTS
Julian J. Bussgang and Michael B. Marcus Feb. 1965 27 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4405-ARPA; AD-612697)

Some fundamental aspects of multi-stage tests of alternate statistical hypotheses are discussed and certain fundamental equalities of the conditional distributions of the sample size which occur in Wald's sequential probability ratio tests are demonstrated. These equalities imply that the terminal decision is a sufficient statistic for the estimation of the true hypothesis regardless of the terminal stage. Using information theoretic concepts, the rate of transmission of a statistical test is defined and a test procedure, constructed to satisfy these equalities, is shown to minimize this rate. The information theoretic view of an alternate decision problem has been suggested before, but only for a fixed sample test. The results of this study provide an alternate approach to the optimality of multi-stage tests of alternate statistical hypotheses and suggest a criterion for designing such tests based on the conditional distributions of the sample size rather than on the average risk. E.E.B.

N65-25999*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHASE ERROR AND ASSOCIATED CROSS-POLARIZATION EFFECTS IN CASSEGRAINIAN-FED MICROWAVE ANTENNAS
W. V. T. Rusch 30 May 1964 27 p refs
(Contract NAS7-100)
(NASA-CR-63343; JPL-TR-32-610) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Phase error in the aperture field of a microwave paraboloidal antenna degrades antenna gain in two ways; the asynchronism of partial field contributions arriving at an axial field point reduces the magnitude of the total field there, and the phase error may generate a cross-polarized component of the aperture field that further reduces the axial gain. Because of phase ripples in the field reflected from the subdish, a Cassegrainian-fed antenna may be considerably more susceptible to phase-error effects than conventional focal-point-fed antennas. Consequently, a two-part analysis was carried out to evaluate the importance of these phase-error effects in Cassegrainian systems. The feed-system fields were computed and a best-fit phase center was found. Then the axial gain was computed in terms of the feed-system fields. An expression for the phase-error loss was defined to evaluate the effects of diffractive phase ripple, feed-system misalignment, etc. Numerical analyses were carried out for a wide range of antenna parameters. It was concluded that for a 19-wavelength subdish and a nearly symmetrical phase and amplitude feed pattern the loss in axial gain due to diffractive phase error may be only a small fraction of a decibel. Author

N65-26014# Raytheon Co., Wayland, Mass. Equipment Div.
SYSTEMS ANALYSIS AND ADDITIONAL INSTRUMENTATION FOR MODIFIED "PORCUPINE" C-BAND PULSE DOPPLER RADAR Final Report, Aug. 1963–Nov. 1964
Frederick E. Compton, Edward E. Cox, and Herbert L. Groginsky 30 Nov. 1964 75 p refs
(Contract AF 19(628)-494)
(AFCRL-64-985; AD-613048)

This report summarizes the principal work performed by Raytheon Company during the period 1 September 1963 to 31 October 1964. Work was performed under extension to Contract No. AF19(628)-494 for Air Force Cambridge Research Laboratories, Office of Aerospace Research. Section one of this report contains systems analysis work performed in two areas. The first work is a mathematical analysis of the zero crossing counter performance by Dr. Herbert L. Groginsky. The second work is a theoretical short range sensitivity analysis by Edward G. Cox. Section two contains procedures and results of a VSWR and a high power test performed on the Porcupine Antenna System. Section three contains documentation for the more significant circuits and displays which were implemented during the period of this report. Author

N65-26027# Aerospace Corp., El Segundo, Calif. Tracking and Radar Dept.
SATELLITE CONTROL FACILITY. DESIGN CRITERIA: MULTIPURPOSE FEED FOR SIXTY-FOOT PARABOLOID ANTENNAS AT 225-260, 375/400, 1700-1850, AND 2200-2300 Mc AND NASA UNIFIED S-BAND (AT 2100-2120 AND 2270-2300 Mc)
H. N. Chait 30 Jun. 1964 28 p Supersedes TOR-269(4110-01)-32, Feb. 1964
(TOR-269(4110-01)-32, Reissue A; AD-461534)

Performance requirements and test procedures for an improved feed system for the 60-foot paraboloid reflectors with focal lengths of 25 feet are presented. The antenna shall have the following independent capabilities: receive at 225 to 260 Mc, 400.5 ±1 Mc and 2250 ±50 Mc while autotracking at either 225 to 260 Mc, 400.5 ±1 Mc or 2250 ±50 Mc and transmitting 10 kw at 375 ±1 Mc and 1700 to 1850 Mc with the 375–400 Mc and the 1700–2300 Mc portions providing coherent doppler. The feed shall be capable to operation in the Unified S-Band frequency range, with transmission from 2100 to 2120 Mc and reception from 2270 to 2300 Mc. G.G.

N65-26054# IIT Research Inst., Chicago, Ill.
EVALUATION AND IMPROVEMENT OF RADAR BEACON SYSTEMS Final Report, 1 Jun. 1962–31 May 1964
J. Dablowski, J. Feldman, S. Kazel, G. Marazas, and R. Standley 1 Jul. 1964 180 p refs
(Contract DA-36-039-SC-90693)
(AD-461033)

Analysis of the Doppler errors in a coherent radar beacon system showed that rotation rates of up to one rotation per second introduce velocity errors up to sixty times greater than any other error present in the system. Also presented are a summary and review on: (1) coherent pulse-radar tracking modifications and characteristics; (2) parameters and design specifications of a coherent beacon; (3) oscillator phase and frequency errors; (4) filtering of velocity errors due to frequency instability; and (5) spectrum broadening due to frequency instability. Theory and experimental results of C-band guide, and stepped guide tunnel-diode amplifiers are discussed, and the analysis and test results on the dc biasing circuit of C-band tunnel-diode amplifiers are presented. G.G.

N65-26078*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
R. F. TEST CONSOLE Final Report, Mar. 1964–Mar. 1965
G. R. Vaughn et al 10 Apr. 1965 131 p Prepared for JPL *Its* Rept.-65-335
(Contracts NAS7-100; JPL-950144)
(NASA-CR-63290) CFSTI: HC $4.00/MF $1.00 CSCL 17B

The design and development of the linear signal-to-noise summer resulted in a system which met or exceeded rigid performance goals. The principal design parameters, design goals, and test results are tabulated. The study portion of the effort

included an investigation and comparison of a locked oscillator phase modulator and a deviation multiplication phase modulator, including several loop designs. The loop design selected exhibited a closed transfer function whose group delay was constant over the baseband. The design study also included an investigation of the requirements of the pulse modulated receiver, frequency modulated transmitter, frequency modulated receiver, phase noise instrumentation, test plan, and test instrumentation. An investigation of equipment required to correlate system performance against system specifications was also included. E.E.B.

N65-26081*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
[RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS] Annual Summary Report, 1 Sep. 1963–31 Aug. 1964
1 Sep. 1964 15 p refs *Its* Rept. 1093-22
(Grant NsG-74-60)
(NASA-CR-63383) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Investigations of various conventional and nonconventional detection, generation, measurement, and receiver techniques in the millimeter and submillimeter wavelength regions continued. Use of the germanium bolometer eliminated the channel spectra problem, and improved the characteristics of the radiometer. Measurements in the aperiodic mode were made of water vapor absorption over the five-meter path length of the interferometer and good spectra were obtained. An analog-to-digital tape system was designed and incorporated into the radiometer so that aperiodic mode data can be fed directly to the computers for performing the Fourier transforms to obtain the spectra. In the study of submillimeter lasers, measurements were obtained of the solid spectroscopy at submillimeter wavelength on the exchange-coupled levels of concentrated ruby at liquid helium temperatures. Comparative data are shown for this absorption spectrum and for the visible absorption spectrum of the ruby at room temperature. A table listing the submillimeter water vapor absorption lines is also included. M.G.J.

N65-26119# Lenkurt Electric Co., Inc., San Carlos, Calif.
Mc CLELLAN AIR FORCE BASE FIELD TEST REPORT FOR MULTIPLEXER SET AN/FCC-17(V)(XW-1)
James H. Smith 30 Oct. 1964 156 p
(Contract AF 30(635)-11188)
(RADC-TDR-63-439; AD-461674)

The Category II tests evaluated Multiplexer Set AN/FCC-17(V)(XW-1) in service for an extended time within a communications system. The tests were performed to determine the functional capability and compatibility of the Multiplexer Set in as realistic and complete an environment as possible. Initial evaluation test data showed that the performance of the Multiplexer Set was of high quality and would not impair the existing communications system. Recorded data of traffic tests indicate that the Multiplexer Set performs better than the existing system. Final evaluation tests made at the end of the seven-month test period showed no significant changes from the initial evaluation data. With only one subassembly failure during the testing period, the Multiplexer Set exceeded by far the minimum reliability required by MIL-R-26474. Restoration of power after a prime power failure can cause ac circuit breakers on the power supplies to open; this indicates a source of stable prime power is needed for uninterrupted service at unattended sites. However, a design modification is desirable to limit the surge current drawn into the power supply when prime power is applied. Author

N65-26136# Stanford Research Inst., Menlo Park, Calif.
A POWER SPECTRUM PROGRAM FOR ESTIMATING THE DOPPLER PROFILE OF A RADIO CHANNEL Research Memo No. 15
R. F. Daly Oct. 1964 19 p refs
(Contract DA-36-039-SC-87197)
(DASA-1581; AD-613195)

This research memorandum describes a data processing technique for analyzing the Doppler-shift properties of a radio channel. A computer program has been developed that computes the power spectrum of power scattered by the radio channel as a function of Doppler shift. This program was developed in conjunction with phase-stable CW experiments which were performed on two HF paths. The experiments were part of a simulation experiment conducted by Stanford Research Institute for the United States Army Electronics Laboratories and the Defense Atomic Support Agency. The program computes the power spectrum of the time variations of the response of the radio channel to a CW tone relative to the transmitted frequency. Author

N65-26139# Northrop Corp., Hawthorne, Calif. Norair Div.
TERMINAL GUIDANCE SIMULATOR STUDY PROGRAM, IMAGE EVALUATION. VOLUME I: THEORY OF IMAGE EVALUATION
B. Lapidus Jan. 1964 109 p refs
(Contract Nonr-3648(00))
(NOR-64-10; AD-427784)

The purpose of this report is to provide objective methods of assessing characteristics of optical systems as opposed to the usual subjective approach. The objective characteristics considered were transfer characteristic, the sine wave response, and the signal-to-deviation ratio. However, in the final analysis, any valid objective estimate of image quality will have to pass the test of correlation with subjective impressions in future experiments. As a result of the image evaluation experiment and associated studies conducted under this contract, methods are now available to assess the characteristics of imaging systems prior to design. A common language is provided to describe the performance of elements in an optical system so that the complete system can be designed from the characteristics of the constituent elements. In order to effectively use the techniques developed, the requirements and the environment in which the system is to be used must be well defined. Author

N65-26144# Bendix Field Engineering Corp., Owing Mills, Md.
ERROR ANALYSIS OF RADAR SET AN/MPN-13 Final Report
Griffiss AFB, N. Y., RADC, Mar. 1965 108 p refs
(Contract AF 30(602)-2975)
(RADC-TDR-64-489; AD-614048)

This Technical Documentary Report, which presents the results of the Error Analysis Study made in conjunction with the Spectrum Signature Measurements on Radar Set AN/MPN-13, is composed of four sections. The Error Analysis Study was performed on only two (2) of the Spectrum Signature Measurements performed on the AN/MPN-13, Transmitter Spurious Emission and Receiver Spurious Response. Section 1 presents the general test information. Section 2 discusses the technical approach taken during the Error Analysis Study and Section 3 presents a summary of the results and conclusions. Section 4 details the measurements performed and presents all data obtained during the Error Analysis Study. This report is to be used as an input to the Test Operations Group (EMCVM-3) of Rome Air Development Center (RADC) to be used as an aid to future spectrum signature measurement planning. Author

N65-26146*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER MARS 1964 TELEMETRY AND COMMAND SYSTEM

Richard P. Mathison 1 Jun. 1965 27 p refs

(Contract NAS7-100)

(NASA-CR-63289; JPL-TR-32-684) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The Telemetry and Command System for the Mariner Mars 1964 Mission utilizes an extension of the techniques used for the Mariner Venus 1962 Mission. For both the command and telemetry functions, PCM/PSK/PM modulation–demodulation in combination with pseudo-random sync codes is used. The telemetry system is required to transmit video data from the vicinity of Mars in addition to transmitting other scientific and engineering data during the entire flight. Since the rate at which the video data is gathered exceeds the capability of the telemetry channel, storage and playback are provided by an endless-loop tape recorder. In order to provide the maximum reliability within the constraints of available power and weight, redundant elements have been incorporated in the telemetry modulator and the transmitter. The command system provides for the transmission of both direct and quantitative commands to the spacecraft. Author

N65-26171# Army Missile Command, Huntsville, Ala. Inertial Guidance and Control Lab.

AN ACTIVE LOW-PASS FILTER

H.V.White 1 May 1965 9 p

(RG-TR-65-7; AD-463913)

The analysis and design of an active low-pass filter for use in inertial platform systems (though not restricted to this application) are presented in this report. The filter features minimum size and weight and increased reliability through the use of a single micro-circuit, yet it maintains performance comparable to conventional types presently used for the same purpose. Little difficulty should be encountered in making the external circuitry an integral part of the operational amplifier in a finalized version of the unit. Author

N65-26183 Joint Publications Research Service, Washington, D. C.

ON A METHOD OF SOLUTION OF THE PROBLEM OF CLASSIFICATION OF OBJECTS OR PHENOMENA

A. L. Gorelik and B. A. Skripkin *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 81–91 refs (See N65-26175 15-10) CFSTI: $7.00

One of the possible procedures for classification of objects or phenomena is discussed which consists of refering the classified object or phenomenon to one of the classes defined in advance. The suitability of the procedure of sequential statistical solutions is proved for increase in the number of signs used and the procedure for evaluation of effectiveness of the signs used of classified objects or phenomena is proposed. The principle of construction of the statistical model of the classification process is developed. Author

N65-26186 Joint Publications Research Service, Washington, D. C.

DISCRETING OF IMAGES BY SEPARATION AND QUANTIFICATION OF CONTOURS

D. G. Lebedev and D. S. Lebedev *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 125–130 refs (See N65-26175 15-10) CFSTI: $7.00

A means of discreting of images which ensures a significant lowering of the required number of levels of quantification by comparison with the usual discreting procedure is investigated. The procedure is based on separation and quantification of values of brightness of elements of the images which form curves with subsequent reproduction of smooth transition by two dimensional interpolation. Selection of the Laplacian as the operator for separation of the contours is founded. Results of simulation of the proposed procedure for discreting on an electronic digital computer are presented. Author

N65-26187 Joint Publications Research Service, Washington, D. C.

SYNTHESIS AND INVESTIGATION OF DISCRETE SYSTEMS INTENDED FOR TRANSMISSION OF CONTINUOUS MESSAGES. I. SYNTHESIS OF OPTIMAL SYSTEMS

A. I. Velichkin *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 131–146 refs (See N65-26175 15-10) CFSTI: $7.00

The problem of synthesis is solved as applied to communication and automatic control. The criterion of minimum of the mean square error is used. By the procedures of statistical theory of evaluations a general solution of the problem of synthesis of an optimal system is obtained. The case of synthesis of a discrete system for continuous messages characterized by normal probability density is investigated in more detail. Author

N65-26188 Joint Publications Research Service, Washington, D. C.

ON STATISTICAL ACCURACY OF REGENERATING ELEMENTS WITH PULSE TRANSMISSION OF RANDOM SIGNALS

Yu. M. Bykov *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 147–164 refs (See N65-26175 15-10) CFSTI: $7.00

Expressions are obtained which define the relationship of the mean square error in the output restored signal with respect to the initial continuous signal and a function of the ratio of the signal band and the frequency of references for pulse transmission of random signals. The dependencies calculated on the basis of these expressions are presented which characterize the statistical accuracy of some most widely spread means of approximation (or types regenerating elements). Author

N65-26194 Joint Publications Research Service, Washington, D. C.

ON AUTOMATIC TRACKING SYSTEM EQUATIONS

Ye. A. Devyanin *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 220–231 refs (See N65-26175 15-10) CFSTI: $7.00

Automatic tracking systems are considered with canonical scanning. It is shown that under a number of assumptions the system of ordinary differential equations with periodic coefficients which describes the tracking process is reducible by a transition to rotating coordinates. The regions of stability are established for a typical system. The influence of a scanning frequency and the parameters of the input devices on the nature of the stability region is explained. Author

N65-26197 Joint Publications Research Service, Washington, D. C.

SOLUTION OF SOME NONSTATIONARY PROBLEMS OF OPTIMAL FILTRATION

F. P. Dmitriyev, G. Ya. Dolgintseva, and A. A. Ignatov *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 249–269 refs (See N65-26175 15-10) CFSTI: $7.00

The method of solution of some nonstationary problems of optimal filtration are investigated for the case where the differential equations which relate the useful signal and noise with white noise are known. The method investigated includes

as special cases the methods of determination of optimal systems with stationary signals with finite and infinite memory time. Author

N65-26249# Smyth Research Associates, San Diego, Calif.
PROPAGATION MEDIUM RF NOISE Interim Technical Report
May 1965 8 p
(Contract AF 33(615)-2222)
(SRA-451; AD-464660)

Progress is reported on phase one of a program to examine experimentally the magnitude and character of noise and its effect on a typical communication system. Phase one is the preparatory phase during which the necessary electronic equipment is constructed and checked out. During this phase, the preliminary over-all equipment design for the PCM/FM communication system has been completed. The system is discussed under four main headings: (1) PCM/FM operation of the S-band transmitter; (2) phase locking of the reference signal; (3) integration of the received signal; and (4) data recording. A block diagram of the complete system is shown. N.E.A.

N65-26325# New York Univ., N. Y. School of Engineering and Science
ELECTRIC FIELD INTENSITY MEASURING EQUIPMENT
Lance Teschmacher Apr. 1964 38 p refs
(Contract NObsr-89288; Proj. SETE)
(SETE-210/75; AD-460895)

Radiofrequency interference is defined, and the frequency ranges and specifications for both commerical and military nomenclatured electric field intensity meters are given. Companies doing radiofrequency interference testing to military specifications, manufacturers of the military nomenclatured meters, and selected documents specifying requirements for electromagnetic compatibility are listed. A bibliography is also included. L.S.

N65-26326# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
FREE-FLIGHT RANGE MEASUREMENTS OF IONIZATION BEHIND SLENDER HYPERSONIC-VELOCITY CONES
R. I. Primich, R. A. Hayami, D. H. Auston, K. J. Kelley, and J. R. Faulkner Apr. 1965 35 p refs
(Contracts AF 04(694)-582; DA-01-021-AMC-11359(Z); ARPA Order-347; Proj. Defender)
(TR65-19A; AD-463051)

Measurements have been made of wake ionization behind slender 12.5° half-angle cones in a free-flight range at a nominal velocity of 23,000 ft/sec and over a range of pressures in air. Both nonablating and ablating cones were studied, and results portraying the effects of various materials on ionization are presented. An unusual feature of the data is the existence of a very fast electron-removal mechanism which is in marked disagreement with theory. A possible mechanism to explain this anomaly is discussed. Author

N65-26331*# National Aeronautics and Space Administration, Washington, D. C.
FAINT RADIO SIGNALS PROVIDE FIRM LOCK ON MARINER MISSION
16 Jun. 1965 10 p
(NASA News Release-65-198) Available from the Scientific and Technical Information Division CSCL 17B

The Mariner IV flight toward Mars, its experiments, and the tracking by ground stations are summarized. During the week prior to fly-by, Deep Space Network (DSN) stations around the world will track the spacecraft from horizon to horizon each day, and the overlap in their observations will provide continuous coverage. The Mariner IV radio signals received by the big dish antennas at the DSN stations currently have a strength of slightly less than 10^{-19} watt. Accurate tracking by a two-way Doppler technique is one of the major Mariner IV experiments. On July 14, 1965 the spacecraft will come within 6,000 miles of Mars and will transmit binary signals back to earth for decoding into pictures. I.M.D.

N65-26345# Bureau of Reclamation, Denver, Colo. Chemical Engineering Branch
CORROSION INVESTIGATIONS, TRACY–RED BLUFF, CALIFORNIA. EHV DIRECT-CURRENT TESTS
T. E. Backstrom 15 Sep. 1964 32 p
(ChE-34; AD-609766)

One important test in a series of EHV d-c transmission tests using a ground return system performed between Tracy and Red Bluff, California, was the evaluation of the effect of introduction of direct current into the ground on the corrosion of buried metalwork. Test measurements were made to determine the maximum distance from the two types of electrodes at which corrosion prevention procedures would be necessary for protecting buried metallic structures. It was concluded that the use of EHV d-c ground return at current levels used in the tests would: 1/ promote serious corrosion of buried metalwork in Area 1 (within approximately 1/2-mile radius of the electrode) if a ground mat electrode were used and mild corrosion if a deep-well electrode were used; 2/ promote negligible to serious corrosion of buried pipelines in Area 2 (1/2-3 mile radius of either a ground mat or deep-well electrode) depending upon (1) the distance of the pipelines from the electrode (2) the geometry of the two electrode-pipeline systems and (3) the horizontal extent of the pipelines; 3/ impress no significant stray currents on buried pipeline in Area 3 beyond approximately a 3-mile radius of the electrode. Normal corrosion prevention techniques are fully adequate to prevent stray current corrosion of buried metalwork if proper location of the electrode is made. These conclusions must be modified to reflect the anticipated time-current product. Author

N65-26401*# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
DEVELOPMENT OF AN OPTICAL SUPERHETERODYNE RECEIVER Summary Report, Mar. 1964–Mar. 1965
R. F. Lucy, ed. 17 May 1965 97 p refs
(Contract NAS8-11588)
(NASA-CR-63393; F-4065-1) CFSTI: HC $3.00/MF $0.75 CSCL 09F

This report describes the technical investigations performed during the design and development of an optical superheterodyne receiver. The net result of this effort has produced a tested design for a field model system. The investigations described include the testing of an experimental over a 6000 foot path, theoptics, photomixing, doppler frequency tracking, optical frequency translation techniques and spatial alignment of the received signal and local oscillator. Author

N65-26403*# Smithsonian Astrophysical Observatory, Cambridge, Mass. Data Div.
CATALOG OF SATELLITE OBSERVATIONS, NUMBER C-40
Beatrice Miller 3 May 1965 96 p
(Grant NsG-87-60)
(NASA-CR-63425; SAO Special Rept.-177) CFSTI: HC $3.00/MF $0.75 CSCL 17H

Ground observations of the positions of various satellites for periods during 1958 to 1964 are tabulated. The satellites observed are Explorer I, Vanguard II, Vanguard III, Echo I and Echo I rocket. The observations were made by United States

and foreign observatories, Smithsonian Astrophysical Observatory camera stations, moonwatch teams, phototrack stations, and military installations. The basic data are month, day, and time of day for the readings of right ascension, declination, azimuth, and altitude. Included with each observation is the name of the station and the type of instrument used, an indication of coordinate system and corrections, the equator and equinox, and a measure of the precision of time and position readings. J.M.D.

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N65-26404*# Smithsonian Astrophysical Observatory, Cambridge, Mass. Data Div.

CATALOG OF SATELLITE OBSERVATIONS, NUMBER C-41

Beatrice Miller 5 May 1965 71 p

(Grant NsG-87-60)

(NASA-CR-63426; SAO Special Rept.-178) CFSTI: HC $3.00/MF $0.75 CSCL 17H

Ground observations of the positions of various satellites for periods during 1960 to 1964 are tabulated. The satellites observed are Explorer VIII, Explorer IX, Transit 4A, Injun Solar Radiation 3, Cosmos 3, S51/UKI, Telstar 1, Cosmos 8, and Alouette. The observations were made by United States and foreign observatories, Smithsonian Astrophysical Observatory camera stations, moonwatch teams, phototrack stations, and military installations. The basic data are month, day, and time of day for the readings of right ascension, declination, azimuth, and altitude. Included with each observation is the name of the station and the type of instrument used, an indication of coordinate system and corrections, the equator and equinox, and a measure of the precision of time and position readings. J.M.D.

07

N65-26444# Cubic Corp., San Diego, Calif.

AN INVESTIGATION OF TRACKING, TELEMETRY, AND COMMAND SYSTEMS SUSCEPTIBILITY TO RADIO INTERFERENCE Interim Engineering Report

R. Bruce, R. Derenthal, P. Nelson, and G. Rutherford 6 Mar. 1964 136 p refs

(Contract AF-33(657)-11385)

(IR-39-2; AD-461537)

This report covers the preliminary analysis and the development of the interference prediction model for the integrated Tracking, Telemetry Command (TTC) System model up to the point of converting the results of the analysis into computational procedures. The environment and the system were analyzed to determine what had to be included in the model, the basic steps and sequence of the model, and methods of evaluating interference effects in each portion of the system. A preliminary program for the environmental phase has been completed and a sample test case run. The work to date indicates that a workable interference prediction model can be automated for application to the general class of integrated Tracking, Telemetry, and Command (TTC) systems described in the First Interim Engineering Report, IR/39-1. Author

07

N65-26567# Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.

SOME ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS OF THE LANCE CONSTANT-BANDWIDTH TELEMETRY SYSTEM

William C. Kelly May 1965 31 p

(RG-TR-65-8; AD-464746)

This report contains an investigation of the constant-bandwidth telemetry system used in the LANCE missile. An analytical study evaluates the adjacent-channel interference and the intermodulation distortion of the system. A portion of the report presents the results of experimental tests on output noise associated with several types of modulation, system linearity, and overall drift. The test results are evaluated and compared with the findings of the analytical study. Author

N65-26614# White Sands Missile Range, N. Mex. Instrumentation Development Directorate

THE CROSS-SECTION MEASUREMENT CAPABILITIES OF THE AN/FPS-16

Irvin Mc Clintock Jan. 1965 72 p refs

(STEWS-ID-65-2; AD-460531)

The cross-section measurement capability of the standard AN/FPS-16 radar is evaluated. Particular attention is given to the radar's ability to measure targets which scintillate rapidly and strongly and cause pulse broadening. Modifications to increase the measurement accuracy are recommended, and error estimates formulated. Author

N65-26622# Library of Congress, Washington, D. C. Aerospace Technology Div.

ON THE INFLUENCE OF FOG ON THE RANGE OF GROUND COMMUNICATION AT THE OPTICAL CARRIER [O VLIYANII TUMANA NA DAL'NOST' NAZEMNOY SVYAZI NA OPTICHESKOY NESUSHCHEY] Translations of Soviet-Bloc Scientific and Technical Literature

S. P. Yerkovich, Yu. V. Pisarevskiy, F. S. Ageshin, and G. A. Tregubov 3 Jun. 1965 11 p refs Transl. into ENGLISH from Elektrosvyaz' (Moscow), no. 12, 1964 p 16–21

(ATD-T-65-36; AD-464576)

Methods of computing the communication range in the open atmosphere in the presence of fog are under study. In the absence of atmosphere, the useful signal at the receiver input is determined by the expression:

$$S = \frac{\Omega R^2}{PA}$$

If radiation scattered by the atmosphere penetrates into the receiver, the maximum radiation noise caused by scattered solar radiation lies in the region of 0.5μ. When ground objects which scatter solar radiation are in the line of sight of the receiver, the maximum radiation noise is displaced toward longer wavelengths, dur to Rayleigh scattering in the atmosphere which brings a transformation of the solar spectrum curve. The maximum drop distribution of water according to size in fog depends on altitude. The values for p_m in clouds are high, and weak light scattering in the clouds and low light absorption in the atmosphere cannot occur simultaneously in any sector of the visible and infrared ranges of the spectrum. However, the comparatively small thickness of clouds makes it possible to establish optical communications. R.W.H.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-25598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA PERT TIME II

Ross C. Bainbridge and Elizabeth Ryan Washington, NASA, Jun. 1965 21 p ref

(NASA-TN-D-2863) CFSTI: HC $1.00/MF $0.50 CSCL 09B

Flexibility, adaptability, and efficiency are the prime considerations of the NASA PERT Time II program, which is designed to be compatible with current and future data processing equipment configurations in use throughout both government and industry. It is also compatible with standards of input/output and is designed to cross computer manufacturing lines. The program can easily be modified to change the approach of analyzing methods of reporting PERT time networks. The capacity of the program exceeds 30,000 activities when utilizing a modular technique. Author

N65-25619# National Bureau of Standards, Washington, D. C. Data Processing Systems Div.
RANGE DATA HANDLING INTEGRATION STUDIES. IN-LINE TRANSLATORS INCORPORATING BINARY/DECIMAL CONVERTERS Final Report
Walter D. Urban Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1964 54 p
(NBS-8578; ESD-TDR-65-195; AD-612767) CSCL 09A

The application of in-line translators is covered in terms of the specific adaptation of a wired program device which can efficiently handle the translation between different numerical radices or number base codes. Design criteria, feasibility, and a functional description are presented. Since the radix converter is the central and primary modular element of the translator concept, the logic designs for four principal types of decimal/binary converters are described in detail. Author

N65-25624# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
ZONE SELECTION IN ASSOCIATIVE MULTICHANNEL PULSE ANALYSIS
I. N. Hooton, S. A. Hickman, G. M. Prior, and G. C. Best May 1965 9 p refs
(AERE-R-4925)

In the multiparameter analysis of nuclear physics data the hardware required may be greatly reduced by the use of associative storage. If zones within the spectrum are automatically selected for individual channel analysis, the associative storage may be reduced. The efficiency of such a system is examined and a method of achieving it is outlined. Author

N65-25788# Massachusetts Inst. of Tech., Cambridge.
CTSS TECHNICAL NOTES
J. H. Saltzer [1963] 83 p ref
(Contract Nonr-4102(01); Proj. MAC)
(MAC-TR-16; AD-612702)

The 7094 Compatible Time Sharing System in use at Project MAC and the M.I.T. Computation Center is described. It is designed to acquaint a system programer with the techniques of construction which were used in this particular time-sharing system. Discussions include overall supervisor program flow, console message input and output, and scheduling and storage algorithms; a thumbnail sketch is given of each of the subroutines which make up the supervisor program. This report was prepared with the aid of the compatible time-sharing system and the TYPSET and RUNOFF commands. Author

N65-25796# System Development Corp., Santa Monica, Calif.
NONPARAMETRIC IMPLICATIONS OF RANDOM CONVERSION OF DISCONTINUOUS DATA TO NEARLY EQUIVALENT CONTINUOUS FORM
John E. Walsh 12 Mar. 1965 21 p refs
(SP-463/000/01; AD-613000)

An approach for converting discontinuous data to almost equivalent continuous form with respect to nonparametric use is considered from both the theoretical and application aspects. In some cases, the property investigated is exactly preserved by the conversion. Often, the change in the property, due to the conversion to continuous data, is unimportant. Even when the change is important, bounded probability results can sometimes be obtained by suitable conversion of the data to continuous form. Author

N65-25797# Brown Univ., Providence, R. I. Dept. of Applied Mathematics
THE AUTOMATIC INTEGRATION OF A FUNCTION WITH A PARAMETER
Philip Rabinowitz [1964] 7 p refs
(Contract Nonr-562(36))
(AD-612684)

Two efficient methods for automatic numerical integration are Romberg and adaptive Simpson. For integrands of the form $f(x)g(x,\alpha)$, where α is a parameter, it is shown that Romberg's method is more efficient. A Fortran program shows how to achieve this greater efficiency. Author

N65-25800# Joint Publications Research Service, Washington, D. C.
CYBERNETICS
V. M. Glushkov, ed. 9 Jun. 1965 266 p refs Transl. into ENGLISH from Kibernetika (Kiev), no. 1, Jan.–Feb. 1965 104 p
(JPRS-30525; TT-65-31223) CFSTI: $6.00

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14. INPUT LANGUAGE OF A COMPUTER FOR ENGINEERING CALCULATIONS V. M. Glushkov, A. A. Letichevskiy, and A. A. Stogniy p 192–210 (See N65-25814 15-08)

15. THEORY AND APPLICATION OF ONE METHOD OF ELECTRIC CIRCUIT CONTROL G. Ye. Pukhov and V. V. Vasil'yev p 211–229 refs (See N65-25815 15-10)
16. HIGH SPEED SORTING ALGORITHMS IN AN OPERATIONAL MEMORY V. P. Gladun and Z. A. Rabinovich p 230–248 refs (See N65-25816 15-08)
17. SCIENCE NEWS p 249–252
18. NEW BOOK REVIEW p 253–255

N65-25801 Joint Publications Research Service, Washington, D. C.
THEORY OF AUTOMATA AND DESIGN PROBLEMS OF DIGITAL COMPUTER STRUCTURES
V. M. Glushkov *In its* Cybernetics 9 Jun. 1965 p 5–23 refs (See N65-25800 15-08) CFSTI: $6.00.

A study of the applicability of infinite automata theory to the design of the logic structures of electronic digital computers, which focuses on the development of those concepts of infinite automata theory which will allow the revision of a series of practical problems in the synthesis and optimization of digital computer structures, and allow the use of algebraic methods for the solution of these problems, is reported. Considered is the concept of the infinite (in one or both directions) tape (abstract register) divided into cells, each of which has a finite information capacity. Abstract register is defined as a finite or denumerable set of variables (elements of the register), with the same finite region of determination P, which are numbered by sequences of whole numbers and are ordered in accordance with this numeration. Included is a discussion of bilaterally infinite, unilaterally infinite, and finite registers; and a discussion of special types of register transformations as: periodic-determinate, periodic-determinate with auxiliary variables, finite determinate, and setting, transformations. All definitions introduced are directly generalized to multi-register automata. A comparative analysis of single- and multi-register automata, which focuses on the pros and cons of both systems, is included. S.C.W.

N65-25802 Joint Publications Research Service, Washington, D. C.
LOCAL ALGORITHM OF DATA COMPUTATION, I
Yu. I. Zhuravlev *In its* Cybernetics 9 Jun. 1965 p 24–48 refs (See N65-25800 15-08) CFSTI: $6.00

A theoretical analysis of a natural class of algorithms, which do not contain algorithms equivalent to solving broad classes of problems or to the sorting of all or nearly all possible variants, is presented. Included is a proposed definition of the local algorithms, and data on their general properties. Data in support of the existence of local algorithms with specified parameters, which can be used for several problems, are also included. It is shown that for many problems of a discrete nature, there do not exist universal local algorithms with acceptable parameters. It is concluded that, results may be interpreted as indicating the absence of algorithms with limited sorting for the solution of such problems. S.C.W.

N65-25803 Joint Publications Research Service, Washington, D. C.
MINIMIZATION OF FINITE AUTOMATA
A. A. Letichevsky *In its* Cybernetics 9 Jun. 1965 p 49–55 refs (See N65-25800 15-08) CFSTI: $6.00

Described is a method for the economical minimization of the number of states of automata, which takes into account the structure of the transitions of the automata, and which uses certain properties of the primary series of subautomata of a given automaton and the closely associated concept of the automat layer. The method can be used if the automaton has a sufficiently long primary series and the number of states in each layer is small in comparison to the total number of states, can be applied to strongly coupled automaton if there is a state which is not equivalent to any other state, and can be used in the resolution of problems which involve finding all the congruence relations of a given automaton. S.C.W.

N65-25808 Joint Publications Research Service, Washington, D. C.
CODING OF ABSTRACT AUTOMATA WITH C-CODES
Yu. V. Kapitonova *In its* Cybernetics 9 Jun. 1965 p 103–114 refs (See N65-25800 15-08) CFSTI: $6.00

A theoretical analysis of the prerequisites and necessary conditions for coding the finite abstract automaton A(n,m) by a C-code, is presented. Proposed are several constraint conditions for eliminating inherent problems in the arbitrary method of coding when operating with a real circuit. Emphasized is the constraint condition which is used in coding the neighboring states of the automaton with neighboring codes. Considered in the analysis are a set of binary codes of length L which have either of the following relationships: different neighboring, pairwise neighboring, mixed, and states having no neighbors. Included are two theorems which permit the formulation of an algorithm which can be used in coding the states of the automaton with C-codes, and which has been programed, tested, and used on the Kiev electronic computer. S.C.W.

N65-25814 Joint Publications Research Service, Washington, D. C.
INPUT LANGUAGE OF A COMPUTER FOR ENGINEERING CALCULATIONS
V. M. Glushkov, A. A. Letichevskiy, and A. A. Stognly *In its* Cybernetics 9 Jun. 1965 p 192–210 (See N65-25800 15-08) CFSTI: $6.00

Presented is a description of an input language for a computer which can be used in the solution of small engineering problems having a small volume of input data. The possibility of the partial renewal of the program with retention of the results obtained in the previous stages of operation, has been incorporated to eliminate the repeated insertion of the same information. Although the proposed computer input language is similar to the Algol-60 language, basic differences are found in the simplicity of its program structure and syntactical description. The program written in the computer input language consists of two parts: an operational portion which is a sequence of operators, each of which determines some simple or complex action; and a descriptive portion, which contains a description of the methods used in computing certain quantities encountered in the program and the values of the reference data. Included is a discussion of the basic symbols which are used in the input language, and arithmetical expressions for use in the determination of the sequence of operations which must be performed for the computation of a single numerical value. S.C.W.

N65-25816 Joint Publications Research Service, Washington, D. C.
HIGH SPEED SORTING ALGORITHMS IN AN OPERATIONAL MEMORY
V. P. Gladun and Z. A. Rabinovich *In its* Cybernetics 9 Jun. 1965 p 230–248 refs (See N65-25800 15-08) CFSTI: $6.00

A theoretical analysis of two high speed algorithms for sorting in an operational memory, which are based on the development of special matrices in which the codes of the sorted lines are recorded, is presented. Considered is an algorithm for use when among the sorted lines there are no lines having the same key, and an algorithm for use when among the sorted lines there are lines with identical keys or when there exists the necessity of economizing the memory. It is noted that these algorithms are effective if the set of machine operations permits access to the separate fields and digits of the cell code. The advantages of the proposed algorithms, in comparison with the two-path

merging method and the Hildebrandt-Isbitz method, are discussed. Included is an evaluation of the operational speed of the algorithms, which considers referrals to the operational memory which are not associated with transferrals or exchanges of the sorted lines, and the operations of addition or subtraction of unity in the counter. S.C.W.

N65-25826# Aeronutronic, Newport Beach, Calif.
SPIRAL DECAY AND SENSOR CALIBRATION DIFFERENTIAL CORRECTION PROGRAMS. VOLUME III: PROGRAMMER'S MANUAL
T. G. Gaa, C. G. Hilton, P. A. Vanderstucken, and L. G. Walters Feb. 1965 261 p
(Contract AF 19(628)-3377)
(U-3007; ESD-TDR-65-76; AD-613294)

A programer's handbook for the coding, function, and logic of the Spiral Decay computer program is presented. The system will accept sensor observations, assign weights and biases to the data, perform a differential correction, and predict past or future position and velocity. A detailed description of each subroutine used by the Spiral Decay is given, and an appendix contains the integration routine for ephemeris integration. G.G.

N65-25961# Western Reserve Univ., Cleveland, Ohio. Comparative Systems Lab.
METHODOLOGY FOR TEST AND EVALUATION OF INFORMATION RETRIEVAL SYSTEMS
W. Goffman and V. A. Newill Jul. 1964 24 p refs
(Grant AF-AFOSR-403-63)
(CSL-TR-2; AFOSR-65-0587; AD-614005)

Information retrieval systems are discussed in terms of their purpose and function. The essential components of an information retrieval system are defined. A methodology for evaluating the comparative performance of systems is developed. Specific measures and methods of analysis of results are presented. Author

N65-25988# System Development Corp., Santa Monica, Calif.
A SUMMARY OF AN ANALYSIS OF COMPUTER PROGRAMMING COST FACTORS
Leonard Farr and Henry J. Zagorski 25 Jan. 1965 23 p refs
(Contract AF 19(628)-3418)
(TM-1447/002/00; AD-612947)

Results of an exploratory analysis aimed at deriving better cost-estimating relationships for computer programming are presented. Based upon previous work that hypothesized an initial list of factors affecting cost, this report describes the collection and analysis of data for the purpose of evaluating the presumed factors. Initial equations for estimating costs in terms of such resources as man months and computer hours were derived. However, these prediction devices were evolved from a small and, perhaps, unrepresentative sample of programs. As a result, the equations have large standard errors, i.e., the reliability of an estimate calculated from the equations is low. Therefore, their use is not recommended for actual planning. However, their experimental use is suggested and encouraged. The study demonstrates the usefulness of multivariate regression analysis for deriving programming cost-estimating relationships. To improve the prediction equations, recommendations are made toward revising the data collection questionnaire, extending the survey to a larger and more representative sample, and broadening the investigation into other needed areas of program development. Author

N65-26086# Joint Publications Research Service, Washington, D. C.
EFFECTIVE ORGANIZATION OF THE DYNAMIC USE OF MEMORY
M. R. Shura-Bura and V. V. Martinyuk 7 Jan. 1965 9 p ref Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 5 p 963–967
(JPRS-28181; TT-65-30085) CFSTI: $1.00

A three-address computer with a nine-order operation code and twelve order addresses is described, where the dynamic distribution of memory is based on the so-called mathematical addresses, thus guaranteeing a continuous addressing of all external memory installations. An example of the dynamic transfer of one command during the time of three to four elementary logical operations is carried out. G.G.

N65-26094# System Development Corp., Santa Monica, Calif.
TIME-SHARING SYSTEMS: REAL AND IDEAL
Louis Gallenson and Clark Weissman 11 Mar. 1965 22 p refs Presented at the Conf. on the Impact of Batch Fabric. on Future Computers, Los Angeles, 6–8 Apr. 1965
(Contract ARPA SD-97)
(SP-1872; AD-612940)

To aid in future design for large-scale, general-purpose, time-sharing systems, an appraisal of the existing time-sharing system showed that improvements for increased user satisfaction can be made in continuity of system operation, responsiveness of the system to interrogation, and accessibility to users programing through many different languages and at input–output consoles located remote from the computer. Continuity of operation depends upon reliable equipment, particularly peripheral input–output devices, and upon a reliable time-sharing system executive program. Though the mean-time-to-failure of the system is important, the mean-time-to-discontinuity is also of serious import. About 7% of the time-sharing-system executive and about 25% of the executive operate time is devoted to the scheduling of user's programs, so that system responsiveness, called the response cycle, is within 2 seconds of a user's query. An ideal time-sharing system for the late 1960's is derived to service double or triple the number of users and to allow user programs to be three times as large as current programs. Remote input–output keyboards and display consoles using electroluminescent panels are also discussed. E.E.B.

N65-26097# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE SOFTWARE PROBLEM
D. B. Yntema 4 Sep. 1964 19 p ref Presented to the Gen. Res. Panel of the Lincoln Lab. Joint Advisory Comm., 9 Apr. 1964
Its Group Rept.-1964-51
(Contract AF 19(628)-500)
(ESD-TDR-64-370; AD-605824)

The question of making digital computers more useful to technical personnel like engineers and scientists is discussed informally. It is suggested that computing systems should be designed for a type of use described as "step-display-look." It is also suggested that once the user has been put on-line, the problem of software becomes critical. In particular, the clerical labor that is usually required in instructing the computer becomes an important obstacle to rapid interaction between man and machine. The requirements for an experimental system intended to put these opinions into practice are sketched, and some of the major decisions that have been made in planning such a system are discussed briefly. Author

N65-26181 Joint Publications Research Service, Washington, D. C.
DECODERS WITH FEW ELEMENTS
B. V. Obraztsov *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 63–69 refs (See N65-26175 15-10) CFSTI: $7.00

On the basis of the noted peculiarity of structural formulae of decoders the possibility is shown of combining the two-sided method developed by the author (the two-pole method) of diode grids with division of the variables of the structural formulae into groups for realization of structural formulae of decoders. An algorithm is discussed for construction of decoders which gives a total economy of diodes and additional resistances from 30 to 70% by comparison with the known economic decoders. The use of the algorithm for construction of binary decoders with different control elements is investigated. Author

N65-26184 Joint Publications Research Service, Washington, D. C.
ON TECHNICAL REALIZATION OF AN OPTIMAL TWO STAGE SEARCH
D. A. Novik *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 92–102 refs (See N65-26175 15-10) CFSTI: $7.00

Principles are discussed along with the basic properties proposed by E. Pozner for a two stage optimal search procedure. The requirements are analyzed in detail which are imposed by this procedure on the device for ordering the results of advance investigation. The proposed sequential procedure of ordering of the results of an advance investigation and the device for realizing this procedure are investigated. An estimate for complexity and required rapid action of the basic elements of this device are given. Author

N65-26185 Joint Publications Research Service, Washington, D. C.
LEARNING SYSTEMS FOR RECOGNITION OF PATTERNS USING GENERALIZED PORTRAITS
V. N. Vapnik, A. Ya. Lerner, and A. Ya. Chervonenkis *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 103–124 refs (See N65-26175 15-10) CFSTI: $7.00

The basic assumptions of the theory of learning to recognize shapes using generalized portraits are discussed. Experiments are described in detail on learning to recognize handwritten arabic ciphers and water bearing and oil bearing beds in a well. Author

N65-26252*# General Dynamics/Electronics, Rochester, N. Y.
RESEARCH ON A FERROACOUSTIC INFORMATION STORAGE SYSTEM
J. W. Gratian and R. W. Freytag Washington, NASA, Jun. 1965 43 p refs
(Contract NASw-592)
(NASA-CR-249) CFSTI: HC $2.00/MF $0.50 CSCL 05B

The ferroacoustic memory technique provides nonvolatile, updatable information storage, serial access to data without use of mechanical moving parts, and non-destructive data readout. The storage medium is a strain-sensitive ferromagnetic delay line. Write-in at any specified address is accomplished by the coincidence of a traveling sonic pulse and a properly timed magnetizing current pulse applied along the axis of the entire line. Evaluation of single-line models operated at a data rate of 330 kc show practicable S/N over a temperature range of −20° C to +85° C. Performance and physical characteristics for multiple-line memories are estimated. Investigation of advanced approaches for improving speed and data densities includes exploration of ultra-thin, mill-processed media and thin films. Improved procedures for the measurement and interpretation of strain-sensitive material characteristics, and progress in the study of both isotropic and anisotropic thin films, are discussed. Author

N65-26350# RAND Corp., Santa Monica, Calif.
USE OF HYBRID COMPUTING IN DESIGN AUTOMATION
P. Brock and A. J. Rowe (Hughes Aircraft Co.) Mar. 1965 29 p refs
(P-3086; AD-613002)

A number of computer devices, now available for assistance in engineering and drafting are discussed. Consideration is given to programming language requirements. Other aspects of the problem include questions of information storage and retrieval, numerical machine controls, and more efficient computational methods for design, including simulation and heuristic techniques. TAB

N65-26428# Massachusetts Inst. of Tech., Cambridge. Operations Research Center
SEQUENTIAL SEARCH AND DETECTION. APPLICATIONS OF PROBABILISTIC SYSTEM MODELS Technical Report
Stephen Michael Pollock May 1964 140 p refs
(Contract Nonr-3963(06))
(TR-5; AD-601641)

Optimal sequential search strategies were obtained and evaluated for use in certain general search situations. The strategies minimize the expected cost of search and resulting decisions, and are sequential in that a decision at any time is dependent on what was observed up to that time. The first situation leads to the formulation of a minimum expected cost sequential hypothesis test. The second situation assumes that the target arrives at some random time. In the first, the searcher makes a terminal decision or measures a random variable with a probability density function dependent on the targets presence. A cost structure is given which assigns costs to wrong terminal decisions and for taking a measurement. In the second, a cost structure assigns a cost to deciding the target has arrived when it has not, and a cost proportional to the time between target arrival and the decision that it has arrived. The sequential strategy and resultant minimum cost for both situations are derived by solving a functional equation of the dynamic programing type. R.N.A.

N65-26565# Aberdeen Proving Ground, Md. Ballistic Measurements Lab.
COMPUTER PROGRAM FOR THE "SINGLE CAMERA ORIENTATION" CASE OF THE GENERAL PROBLEM OF PHOTOGRAMMETRY
Lila M. Butler Dec. 1964 95 p refs
(BRL-1268; AD-463335)

This report presents an electronic computer program for the analytical solution of the "Single Camera Orientation" problem based on the theory documented in Ballistic Research Laboratories Report No. 1065. The most recent developments of the analytical solution for the general problem of photogrammetry, as developed by H. H. Schmid, are incorporated in this program. The program offers sufficient flexibility to solve single camera orientation problems under all conditions. Author

N65-26568# Army Missile Command, Huntsville, Ala. Propulsion Lab.
PREPACKAGED LIQUID BIPROPELLANT POCKET PARAMETRIC DESIGN COMPUTER PROGRAM
Charles J. Arnold and Max Rhoden 3 May 1965 29 p refs
(RK-TR-65-3; AD-464522)

This report describes a computer program useful for bipropellant, storable liquid rocket motor parametric design and

analysis. The program has the capability to generate envelope, weight, and interior ballistic information for a parametric network of designs. A chamber pressure optimization and trajectory evaluation is also provided. At the present time capability is limited to a single propulsion unit with a neutral thrust–time curve. This program has been developed and programmed for the IBM 7094 computer. Input requirements, equations used, and computer outputs are shown. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-25575# Radio Corp. of America, Camden, N. J. Defense Electronic Products
MICROMODULE LIFE TEST First Quarterly Report, 17 Sep.–17 Dec., 1964
G. E. Cannon [1964] 114 p
(Contract DA-36-039-AMC-01462(E))
(CR-65-589-3; AD-613605)

A total of 2950 micromodules were received and given initial tests at room-temperature and at high- and low-temperatures (1475 type DM-3 micromodules and 1475 type XM-1364 micromodules). A total of 117 type DM-3 and 74 type XM-1364 micromodules were found defective on initial test. Acceptable micromodules were placed on life test at elevated temperature, and were performance tested at 500-hour intervals. Author

N65-25579# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SPACE PROGRAM Quarterly Report, Oct.–Dec. 1964
[1964] 39 p
(Contract NOw-62-0604-c)
(U-SQR-64-4; AD-462746)

Progress was made in the following areas: *Space Projects for NASA*—launching of S/N Satellite, electronic design for DME-A Satellite telemetry system, discrepancy reporting system for DME-A and GEOS satellites, and other studies; *Navigation Satellite*—dual command receiver development, telemetry support for the Oscar satellite program, upgrading of doppler transmitters, development of a reliable resistance welder, measurements of extreme ultraviolet radiation above the earth's atmosphere, radiation studies, and the development of an electronic packaging method; *Geodetic Satellite Project*—high efficiency dc-to-dc converters for satellites, and improved determination of the earth's gravity field, using accurate orbital determinations and data residuals from the doppler tracking of five satellites. G.G.

N65-25595*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
INVESTIGATION OF ELECTRONIC SWITCHES FOR ANALOG AND HYBRID COMPUTATION Technical Note No. 6
John W. Robertson 31 Mar. 1965 32 p refs
(Contract NAS8-2473)
(NASA-CR-63267) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Selected analog switches were investigated to determine the relative performance characteristics of types considered most promising in analog or hybrid computer applications. Measured performance parameters are tabulated and evaluations given modified Guennou chopper, the nonsaturating two- and four-transistor switches, the complementary transistor bridge, the series-shunt unifet switch, and the six-diode bridge gate, all constructed from available standard semiconductor components. Further work should be done with the six-diode bridge gate and with the series-shunt field-effect-transistor switch to optimize their performance for specific analog and hybrid computer functions. Author

N65-25636# Midland-Wright, Kansas City, Kans.
MODERATE PRECISION GLASS-ENCLOSED CRYSTAL UNITS Tenth Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Robert Kinsman [1964] 20 p
(Contract DA-36-039-SC-86717)
(AD-613718)

Seven crystals each at 5, 10 and 20 MC were fabricated from natural quartz. When preproduction crystals were fabricated from cultured quartz, design problems with respect to temperature characteristics were encountered. The production crystal designs for the units to be fabricated from natural quartz were finalized on the basis of the engineering samples. These designs are included. Author

N65-25705 Joint Publications Research Service, Washington, D. C.
A THYRATRON OSCILLATOR FOR AUDIO AND ABOVE-AUDIO FREQUENCIES
B. A. Belkin *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 41–47 refs (See N65-25700 15-10) CFSTI: $5.00

The steady-state condition of a thyratron oscillator is analyzed when the damping in the tank circuit is small. Expressions are derived for the period and amplitude of oscillations. The operating voltage of the thyratron is calculated. Author

N65-25732# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
DESIGN AND DEVELOPMENT INVESTIGATIONS OF A LOW NOISE, LINEAR, VARIABLE GAIN, R. F. AMPLIFIER TUBE Final Report, Jun. 29, 1963–Feb. 28, 1965
J. P. Pietrzyk, A. van der Jagt, and R. L. Pear 26 Feb. 1965 258 p
(Contract NObsr-89530)
(AD-612666)

A description is given of the development work for an rf amplifier tube, useable in the 0 to 200 Mc/s frequency range, which exhibits less interferences, as cross modulation, intermodulation, hum modulation, and desensitization than in other, presently used, rf tubes. This tube is type WX4733A. The development of a similar tube, which is indicated as tube type WX4733D, capable of a satisfactory amplification for a frequency range up to 400 Mc/s with a similar interference rejection, is described. An evaluation of tube type WX4733A in the Navy receiver R390A is given. Author

N65-25736# General Electric Co., Owensboro, Ky. Tube Dept.
DEVELOPMENT OF AN IMPROVED JAN 6299 Addendum to Final Report, 1 May 1961–30 Jun. 1964
1 Feb. 1965 99 p
(Contract DA-36-039-SC-85953)
(AD-612641)

The results of extended life testing are presented in a project to improve the life of electron tube type JAN 6299 to 5000

hours and to determine the nature of any tube failures. Production engineering measures (PEM) and control samples were used. Operating characteristics were recorded at various time intervals for both PEM and control samples. Statistics calculated from sample data include mean values, variance, standard deviation, and coefficient of variation and are tabulated. Both samples developed open heaters during the testing which was attributed to the heater shorting and burning open. There were no significant differences between the failure rates of the two samples. R.N.A.

N65-25755# Texas Instruments, Inc., Dallas.
COMPOUND SEMICONDUCTOR FUNCTIONAL ELECTRONIC BLOCKS Third Quarterly Progress Report, 15 Jun.–15 Sep. 1964
R. G. Moore et al [1964] 44 p refs
(Contract AF 33(615)-1275)
(TI-08-64-144; AD-460932)

Single crystal deposits of GaAs on GaAs seeds containing ppm chromium were produced by co-doping with zinc. Without the zinc, no chromium was found in the deposits. The energy level obtained by doping with zinc plus chromium was 0.33 eV, characteristic of neither dopant alone. While this level does not produce semi-insulating GaAs at room temperature, it indicates the 0.79 eV level in Cr-doped bulk material is a result of interaction between chromium and an unknown, which is not normally present in epitaxial deposits. Mg(Mn) mesa diffused resistors were evaluated. The standard diffusion process produces resistors with a sheet resistance of about 50 ohms/square and a TCR of 3000 ppm/°C. Diffused manganese resistors with sheet resistances of 200–3000 ohms/square were made by diffusing from a doped sputtered SiO_2 film. Deep manganese diffusions into semi-insulating substrates have produced isolation barriers with 40 volts breakdown. The reproducibility of the diffusion profile is very poor, however. Protection of the GaAs surface by an SiO_2 layer has led to successful closed-tube diffusions of tellurium. The surface concentration of zinc diffusions has been lowered by a factor of 10 by changes in the diffusion process. Some electrical characteristics were determined for the logic network in breadboard form. The decision was made to use a Mg(Mn) mesa transistors and a nichrome thin-film resistor. Author

N65-25787# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
HIGH SPEED SEMICONDUCTOR SWITCH (TWO TERMINAL) AND HIGH SPEED SEMICONDUCTOR SWITCH (GATE) Quarterly Report, 29 Aug.–28 Nov. 1964
B. G. Burlingame and W. F. Munzer [1964] 40 p
(Contract DA-36-039-AMC-01475(E))
(QR-6; AD-613275)

Results obtained from studies of the failure mode of the two-terminal device as well as processing techniques, including die-cutting, surface cleanup and preservation and assembly methods, are discussed. Test equipment design and results for the engineering samples are contained. Author

N65-25832# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MEASUREMENTS ON AN L-BAND POWER AMPLIFIER FOR PHASED ARRAYS Technical Note No. 1965-7
L. Cartledge 17 Mar. 1965 13 p
(Contract AF 19(628)-500)
(ESD-TDR-65-63; AD-614426)

An L-band amplifier rated at 5 kW peak, .04 duty, 10% bandwidth, and 50 dB gain was developed. This amplifier consists of two triode and four tetrode stages, and compares favorably with similarly rated TWT amplifiers, when size, weight, and operating voltages are compared. Measurements of the amplifier's complex transfer function were made. Author

N65-25834# Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY AVIONICS EQUIPMENT μ-Notes No. 11
J. H. Namaroff (Naval Air Develop. Center) and M. R. Buffington 1 Apr. 1965 167 p refs Prepared jointly with Naval Air Develop. Center
(NAD-65-251; AD-614116)

Microelectronic research is presented on avionic equipment and includes thermal aspects and heat dissipation techniques in integrated circuitry, technical exploitation of epitaxy in semiconductor devices, and microelectronic power supplies. A list of microelectronic terms and definitions are included. The evaluation of differential, operational, minuteman, and read amplifiers, and their test results are presented. R.N.A.

N65-25838# SFD Labs., Inc., Union, N. J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Seventh Interim Development Report, 1 Jan.–31 Mar. 1965
J. Hentschel Apr. 1965 23 p
(Contract NObsr-89503)
(SFD-33-IDR-7; AD-614251)

Net gains of up to 13 dB were measured using the new helix coupled vane circuit. A nominal net gain of 10 dB was also achieved with essentially constant voltage over the full 15% frequency range of the driver magnetron. Signals well below the expected levels have provided sufficient locking power across this same bandwidth. Author

N65-25841# Naval Ordnance Test Station, China Lake, Calif. Weapons Development Dept.
SILICON P-N JUNCTIONS AS AUTOMATIC GAIN CONTROL (AGC) ELEMENTS FOR VIDEO PULSES
Richard S. Hughes Feb. 1965 57 p refs
(NAVWEPS-8630; NOTS-TP-3662; AD-614280)

The silicon p-n junction is studied from a theoretical standpoint, then compared with actual characteristics. The dynamic resistance characteristic is determined, and typical circuits are presented that illustrate how this variable resistance can be used to control gain (or attenuation) electrically. It is shown that there are four basic characteristics of gain versus AGC voltage: linear, logarithmic, $(\text{logarithmic})^{-1}$, and hyperbolic. These characteristics depend on how the diodes are driven (voltage or current source) and where the diodes dynamic resistance appears in the circuit's gain equation. Author

N65-25868# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESIGN ASPECTS OF MINIMAL-POWER DIGITAL CIRCUITRY
W. G. Schmidt and D. E. Chace 9 Feb. 1965 35 p refs *Its* Group Rept.-1965-6
(Contract AF 19(628)-500)
(ESD-TDR-65-45; AD-612769)

Minimal-power digital circuitry, while a necessity for spacecraft operation, has advantages for both spaceborne and ground-based digital data processing. A compendium of some of the low-power digital circuit designs of the laboratory is included. These techniques have been employed in a number of scientific satellites and space probes. The influence of new semiconductor devices upon the minimal-power concept is discussed. Author

N65-25911# National Co., Inc., Melrose, Mass.
PRODUCTION ENGINEERING MEASURE FOR CESIUM BEAM TUBES Quarterly Progress Report, 23 Aug.–23 Nov. 1964
James George [1964] 50 p
(Contract DA-36-039-AMC-01457)
(QPR-6; AD-614118)

The program is one of Production Engineering Measures for a general purpose cesium beam tube. This program is defined and divided into component tasks, and the tasks performed during the reporting period are described. The life test of the retrofitted PEM-E3 cesium beam tube was continued with satisfactory results. Design and parts fabrication for the original PEM-E5 and PEM-E6 cesium beam tubes were completed. These tubes (PEM-E5 and PEM-E6) were assembled, processed, aligned, tested, and subjected to corrective redesign and retrofitting. The retrofitted PEM-E5 and PEM-E6 tubes were then assembled, processed, aligned, and tested. Only two problem areas remain unresolved in the retrofitted PEM-E5 and PEM-E6 tubes: low signal output and rf power mismatch. Two completely new beam tubes (incorporating the improved design characteristics of the retrofitted PEM-E5 and PEM-E6 tubes) will be built to resolve these problems. During this reporting period, charts showing the fabrication, assembly, processing, alignment, and testing sequences for the PEM-E5 and PEM-E6 tubes were prepared. Author

N65-25917# Microwave Associates, Inc., Burlington, Mass. Tube Div. Research Dept.
APPLIED RESEARCH ON COUPLING SCHEMES FOR PLASMA AMPLIFIERS Final Engineering Report, 1 Oct. 1963–30 Nov. 1964
Paul Chorney 8 Mar. 1965 115 p refs
(Contract AF 33(615)-1110)
(AFAL-TR-65-53; AD-612538)

The concept of gap coupling to a beam-plasma system is studied both theoretically and experimentally. The theory of space-charge waves on one dimensional beam plasma systems is reviewed. The kinetic power associated with the complex waves of the system is examined, and it is proved that power can be extracted from the system even though the individual space-charge waves can carry no power. The action of an applied field on the space-charge waves is examined, and expressions for coupling coefficients are obtained. Computations of the coefficients predict that strong coupling can be obtained with long transit-angle gaps because of the complex waves. The problem of gap coupling to a beam-plasma waveguide is treated by a Fourier analysis, with the result that expressions are obtained for the coupling to each of the modes. X-band experiments are described on 3 study vehicles, each containing 2 plasma gap couplers and 2 re-entrant cavities as standard references. It is found that the presence of the plasma enhances the transmission of signals between the various parts of the study vehicles. The experimental evidence points to the conclusions that the beam should be located close to the gap, but that the gap width can be very long in terms of transit angle. Work is described on a feed system based on the quasi-optical properties of an ellipse. Also described is the development of two window types which are employed in the study vehicles. Conclusions are made based on the results of the program, and approaches are recommended for further investigation of coupling to beam-plasma systems. Author

N65-25944# Microwave Associates, Inc., Burlington, Mass.
APPLICATION OF SEMI-CONDUCTOR DEVICES TO HIGH POWER DUPLEXERS Third Quarterly Report, 1 Oct.–31 Dec. 1964
Daniel Conlon Griffiss AFB, N. Y., RADC, Mar. 1965 25 p
(Contract AF 30(602)-3278)
(RADC-TR-65-52; AD-614649)

This third quarterly report presents the progress made during this period. The work performed was circuit analysis and power handling capability of PIN diodes for use in C-Band. This report is basically a presentation of information. Conclusions could not be drawn until tests begun during this period are concluded in the next quarter. Author

N65-25948# HP Associates, Palo Alto, Calif.
HOT ELECTRON AMPLIFIER Interim Engineering Report, 1 Jul.–30 Oct. 1964
[1964] 35 p refs
(Contract AF 33(615)-2035)
(IER-1; AD-460960)

The vapor deposition of molybdenum and molybdenum–silicon Schottky barriers are discussed. It was observed that molybdenum films prepared by hydrogen reduction of molybdenum pentachloride at a substrate temperature of 700° C are nonoriented and polycrystalline. Also, molybdenum films having a metallic appearance can be deposited on substrates between 600° and 800° C. The growth rate of these films depends on source temperature and $MoCl_5$ partial pressure. The method of deposition of molybdenum by hydrogen reaction with $MoCl_5$ gave molybdenum films having resistivity of 5.4 ±0.4 microhm-cm. Further, the barrier height for the Mo–Si system was found to be approximately 0.64 eV. The molybdenum film and the Mo–Si interface are seriously degraded by heating in vacuum to 1000° C for 2 minutes. E.E.B.

N65-25951# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE RF GENERATOR Quarterly Progress Report, 1 Sep.–30 Nov. 1963
F. P. Collins and C. J. Beanland Jan. 1963 19 p ref
(Contract NObsr-89356)
(QPR-2; AD-427613)

A voltage tuned oscillator was developed that can be tuned over the required frequency range of 35.8 Mc/s to 38.3 Mc/s without any difficulty. Change of the oscillator frequency to approximately 37 Mc/s resulted in zero frequency–temperature characteristics. Also developed was a broadband power amplifier that achieved over 20 watts output with only two transistors in the output stage, and reached 25 watt output with a 60 volt supply by selecting transistors for high breakdown voltage. G.G.

N65-25973*# Barnes Engineering Co., Stamford, Conn.
LOW LEVEL COMMUTATION USING MOS FET TRANSISTORS
Monty M. Merlen and Jerome M. Pasternak 2 Apr. 1965 70 p
Prepared for JPL
(Contracts NAS7-100 JPL-950470)
(NASA-CR-63334) CFSTI: HC $3.00/MF $0.75 CSCL 09A

A feasibility study is presented on the use of metal oxide silicon field effect transistors (MOS FET) as switching elements for a low level commutator. Its properties, operating characteristics, and problems involving a switching spike that appears on the signal output when an FET is gated on and off and the thermocouple action between the dissimilar materials of the device body and connecting leads are discussed. An experimental single pole, five throw MOS FET switch was constructed and the results of its performance during a temperature test and overall performance are given. The experimental results conclude the practicability of using MOS FET transistors in a low level commutator configuration. R.N.A.

N65-26039# Edison Electric Inst., New York.
EFFECTS OF ATOMIC WEAPONS ON ELECTRIC UTILITIES.
Ralph V. H. Wood, Arthur C. Werden, Jr., and Russell L. Berg
14 Jun. 1965 44 p Prepared in cooperation with Federal Civil Defense Admin.
(WT-1173) CFSTI: $2.00

Duplicate electric-power installations consisting of transmission, substation, and distribution equipment were constructed in areas 4700 and 10,500 ft from Ground Zero (GZ) for use in Project 35.1 in the Apple II shot. The test was made to determine the median survival range of the electric equipment; the extent of damage and the nature of the repairs required to restore disrupted service; and the ability of electric systems, in comparison to industrial plants and the residential communities they serve, to withstand the effects of an atomic explosion. The damage was confined to the transmission and distribution circuits at the 4700-ft area and was of such a nature that the equipment could have been easily and quickly repaired. In the same area, typical homes were completely destroyed. Author

N65-26061# Datametrics Corp., North Hollywood, Calif.
STUDY OF UNPOWERED PERSONAL TRANSMITTER TECHNIQUES Research Status Report, 1 Jul.–1 Aug. 1964
10 Aug. 1964 9 p
(Contract AF 33(615)-1130)
(Rept.-8; AD-460976)

Continued research directed towards maximizing the efficiency and stability of breadboard sound powered transmitters, is reported. Preliminary results of a study designed to determine the feasibility of using silicon semiconductors are presented. Results show that silicon transistors have lower power thresholds than germanium transistors. Included are comparative data which indicate the efficiency versus input power of silicon and germanium with a 2000-, and 50,000-ohm source impedance. Included also are data on the test circuit. Continued research is reported on the development of crystal oscillator circuits with reduced buildup time. A breadboard single carrier bipolar demodulator was constructed and tested under closed circuit conditions. Final evaluation of this circuit is pending the RF air path transmission tests. S.C.W.

N65-26068# George Washington Univ., Washington, D. C Human Resources Research Office
THE DEVELOPMENT AND EVALUATION OF AN IMPROVED ELECTRONICS TROUBLESHOOTING MANUAL
James P. Rogers and H. Walter Thorne Mar. 1965 52 p refs
(Contract DA-44-188-ARO-2)
(TR-65-1; AD-614806)

To develop a maintenance manual that would permit a trained technician to troubleshoot electronic equipment faster and more accurately, hypotheses were developed about what information should be presented. An experimental manual was prepared for troubleshooting the Nike Ajax and its test equipment; it contained some information not found in conventional manuals and was organized according to when and how information is to be used. An experimental group using the experimental manual was able to troubleshoot faster and more effectively than a control group using standard schematic and functional diagrams and personal notes. A list of desirable contents for troubleshooting manuals was drawn up, and procedures for preparing troubleshooting manuals were written. Author

N65-26073# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, 29 Sep.–29 Dec. 1964
J. M. Eckfeldt and J. H. D. Folster [1964] 25 p
(Contract DA-36-039-AMC-03621(E))
(QR-6; AD-613215)

Sixteen experimental lots of the 330 microfarad 6V solid electrolyte tantalum capacitors completed life tests, bringing to a conclusion the life testing of preproduction samples of this rating. Descriptions of the composition and processing incorporated in these 16 lots, together with the results of the life tests, are presented. Testing and evaluation of the equipment required for mechanizing the assembly operation continued. Six of the seven items of equipment were approved for use in final production; the remaining item was further modified and is being evaluated. E.E.B.

N65-26080*# Hughes Aircraft Co., Culver City, Calif.
THE STUDY OF MULTIPACTOR BREAKDOWN IN SPACE ELECTRONIC SYSTEMS Fourth Status Report, Jan. 1965
12 Mar. 1965 13 p ref
(Contract NAS5-3916)
(NASA-CR-63387) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Study was continued on a program to define conditions under which multipactor discharges occur in representative space hardware, to evaluate discharge effects when they occur, and to investigate techniques for multipactor prevention which are compatible with other equipment requirements. A successful high vacuum was obtained using beryllium copper electrodes. Measurements were made of both harmonic and noise currents in the electrode structure, and intermodulation distortion coefficients were determined. Tests run on titanium coated electrodes showed an enhancement of multipactor, rather than the expected suppression. An experiment was started to evaluate the effect of dc bias on single and double surface discharges. R.N.A.

N65-26095# Westinghouse Electric Corp., Washington, D. C.
500 WATT SILICON POWER TRANSISTOR Quarterly Report, 1 Nov. 1964–31 Jan. 1965
[1965] 11 p
(Contract NObsr-91001)
(QR-6; AD-612496)

Modifications made in the fabrication of state-of-the-art samples are discussed for diffusion, oxide masking, metallization, and collector contact. The encapsulation design remained essentially as previously described; however, it was found necessary to bond the collector side of the device to a substrate using a soldering technique. A molybdenum disc provides a sturdy support for the silicon, which simplifies the problem of attaching emitter and base leads. The capsule assembly, internal leads, base and emitter leads, pinch welding, current rating of wire, washer springs, deflection adjustment and cushioning, and insulation of washer and sleeves are also discussed. Further, the electrical characteristics of the samples are given. E.E.B.

N65-26103# General Electric Co., Irmo, S. C. Capacitor Dept.
SOLID ELECTROLYTE TANTALUM FOIL CAPACITOR Final Report, 29 Sep.–28 Dec. 1964
A. L. Jenny [1964] 62 p
(Contract NObsr-89380)
(AD-610678)

In developing 150 and 250 volt devices capable of operating at 85°C, it was found that vacuum heat treatments of tantalum foil used for the electrodes improved the final electrical properties. A temperature of 2150°C in a vacuum of the order of 10^{-6} torr was required. The primary objective in developing etching techniques, materials, and processes was to obtain the maximum capacitance at the required formation voltage. Results showed that the removal of tantalum from

the foil during etching is highly efficient, independent of water content, and dependent on coulombs passed through the cell and on the composition of the electrolyte. A new formation electrolyte was developed to attain higher anodization levels on both plain and etched foil. The effects of the number of deposited areas, the concentration of pyrolytic solution, the number of deposits, and formation conditions were studied as related to the voltage breakdown. It was decided that dielectric absorption was significant in determining the type of oxide film most compatible with the semiconductor electrolyte. R.W.H.

N65-26108# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURES (PEM) FOR MICROELECTRONIC CIRCUITRY AND MILLIWATT LOGIC SEMICONDUCTOR INTEGRATED CIRCUITS Quarterly Progress Report No. 1, 1 Jul.–30 Sep. 1964
Don Brooks [1964] 56 p
(Contract DA-36-039-AMC-03637(E))
(TI-03-64-76; AD-614599)

Progress towards the improvement of microelectronic circuitry and milliwatt logic semiconductor integrated circuits is reported. The optimization of microelectronic circuits showed considerable improvements in electrical characteristics. The bar layouts were obtained with minimum area requirements for optimum yield per slice. In a study of the etch systems process technology, the SiO_2 etch rate was found to be dependent on the ratio of NH_4^+ to HF in NH_4F buffered HF solutions. Present production etchants are adjusted to a ratio of 2 to 1 in favor of NH_4^+ at room temperature. It was also noted that the NH_4^+ to HF ratio was very important in determining oxide window slope (degree of fringing). E.E.B.

N65-26122# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURES (PEM) FOR MICROELECTRONIC CIRCUITRY AND MILLIWATT LOGIC SEMICONDUCTOR INTEGRATED CIRCUITS Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1964
D. W. Brooks [1964] 72 p
(Contract DA-36-039-AMC-03637(E))
(TI-03-65-16; AD-614822)

Progress is reported on an effort to manufacture microelectronic circuitry and milliwatt logic semiconductor integrated circuits on a pilot line basis at a rate of 25 of each circuit per 8-hour shift and to fabricate test samples. For microelectronic circuitry, activities were directed toward production of samples of the standard gate, power gate element and bistable multivibrator as per specifications. The standard gate and power gate were completed and are reported in detail. Delay element and bistable multivibrator are progressing smoothly. On the milliwatt logic semiconductor integrated circuits, progress is reported as going extremely well. N.E.A.

N65-26133# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOANEMOMETER WITH DC FEEDBACK
G. F. Appolonov 26 Mar. 1965 10 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 217, 1961 p 176–179
(FTD-TT-64-1043/1+2; AD-614020)

Described is a thermoanemometer that utilizes a tungsten filament with gold plated coating to measure an air flow velocity up to 120 m/sec and velocity pulsation intensity up to 100 000 cycle. An electron dc feedback amplifier automatically compensates the thermal inertia of the filament and rectifies the nonlinear dependence of the signal upon the rate of flow coming from the filament. Measurements of the mean square root values of velocity pulsations are made with the aid of a pulsation amplifier, vacuum thermocouple, and a thermo amplifier. Determination of the velocity pulsation intensity is done by formula. G.G.

N65-26254*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLID STATE, SEQUENTIAL CAMERA TRIGGER CIRCUITS
John F. Fitz Washington, NASA, Jun. 1965 12 p
(NASA-TN-D-2826) CFSTI: HC $1.00/MF $0.50 CSCL 09A

The development and operation of two different solid state, sequential camera trigger circuits are described. Although the trigger circuits are special-purpose, the techniques and methods employed in obtaining a design solution may be applied to a wide range of timing and sequencing requirements. Author

N65-26284# Texas Instruments, Inc., Dallas.
GALLIUM ARSENIDE–INDIUM ARSENIDE ALLOY SYSTEMS Second Quarterly Progress Report, 1 Aug.–31 Oct. 1964
R. W. Haisty, L. G. Bailey, and R. C. Sangster [1964] 31 p refs
(Contract AF 33(615)-1272)
(TI-08-64-172; AD-461531)

During the second quarter, reactor design and operating conditions were worked out to allow controlled deposition over the entire (Ga_xIn_{1-x}). As composition range, including the difficult region of high indium content. Electron mobilities in the n-type deposits have consistently been lower than expected. Attempts to improve the purity of the deposits, including the use of high-purity indium and specially prepared high-purity InAs as feed materials, did not result in increased mobilities. It is believed at present that low mobilities result from strains in the deposit. Annealing experiments now being started are expected to improve mobilities. A theoretical analysis of the graded-band-gap base structure as applied to the (Ga,In)As system has been completed, and the results, showing the performance that seems reasonable to expect, as well as a comparison of factors affecting f_{max}. are reported. Fairly good alloyed diodes were made in p-type InAs, but alloyed diodes in n-type InAs still show excessive leakage. Diffused diodes in InAs are now being evaluated, as are alloyed diodes in (Ga,In) As compositions close to GaAs. Author

N65-26289# SFD Labs., Inc., Union, N. J.
RESEARCH AND DEVELOPMENT ON L-BAND CROSSED-FIELD AMPLIFIER CHAIN Quarterly Progress Report No. 8, 1 Sep.–31 Dec. 1964
H. L. Mc Dowell and A. Wilczek Feb. 1965 38 p ref
(Contract AF 30(602)-2533; ARPA Order 136-61)
(RADC-TR-65-83; AD-614055)

During this quarter, life tests were continued on the Group C, SFD-209 Tubes. Tubes L48E and D37F have operated for 4932 hours and 2368 hours respectively. The life test program has now accumulated a total of 11,881 life test hours. Life testing continues. Construction and RF testing of the group D design tubes was completed. Tube F63F was tested to 1500 watts average power with a 200 microsecond pulse. The performance of tubes F63F and G35F proved that the dependence of performance characteristics on anode-cathode spacing can be predicted. The operating efficiency of tube L7F indicates that, by increasing end hat diameter, the efficiency is raised above 50% at all frequencies in the operating band. Tube J4F indicated that matrix impregnated cathodes, processed in accordance with standard techniques, do not necessarily develop a high secondary emission ratio. The variations in impedance match from tube to tube can be traced to the design of the susceptive matching tabs and the output and input line assembly technique. Author

N65-26304# Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.
A LOW-NOISE, MULTIPLE-FUNCTION, X-BAND TRAVELING-WAVE TUBE Interim Development Report, 1 May–1 Oct. 1964
G. Hodowanec 1 Nov. 1964 62 p refs
(Contract NObsr-87535)
(IDR-9; AD-609572)

This report describes the work done during the feasibility phase of a program to develop a low-noise, X-band traveling-wave tube capable of operating simultaneously as (1) a low-level linear output amplifier, (2) a high-level limited output amplifier, and (3) a high-output video detector. The tube developed in this program was essentially a tube that could be tested and was designed to be amenable to many design changes. This approach enables a thorough evaluation program with a minimum number of "bottle" starts. The work, reported in detail in this report, demonstrates the feasibility of the design approaches which were used to produce the desired tube. Important characteristics of the prototype tubes produced are as follows: At the linear-output port—Small-signal gain = 28 db (nominal); Saturated power output = 10–12 dbm; Noise figure = 14–18 db. At the limited-output port—Gain = 42 db; Saturated power output over entire drive range of −45 dbm to 0 dbm = 0 dbm. At the video output port—Video output over entire drive range of −45 dbm to 0 dbm = 0.5 to 2 volts. The noise figure at the linear output port was, of course, much higher than that desired. This was primarily due to the use of a modified S-band electron gun for these X-band tests. Two interim and three prototype tubes were delivered during this phase of the program. Data on the prototype tubes are given in the appendix to this report. Summaries of experimental results and conclusions are given throughout the body of the report. These data indicate that the performance of the multiple-function tube has indeed been demonstrated and that the desired tube design is highly feasible. The report ends with recommendations that are based on the conclusions given in the text. Author

N65-26375# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Dec. 1964 58 p refs

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N65-26376# Naval Research Lab., Washington, D. C.
HIGH FIELD LOSSES IN PIEZOELECTRIC CERAMICS
Paul L. Smith and A. D. Burbage *In its* Rept. of NRL Progr. Dec. 1964 p 1–8 refs (See N65-26375 15-09)

The loss behavior of commercial piezoelectric ceramics under high alternating fields was compared by a direct measurement of the temperature rise induced in a standard specimen under the action of the field. Both lead titanate zirconate and barium titanate compositions were obtained from a large number of commercial sources. It was found that materials very similar in low-field properties showed wide variation in heating behavior under high fields. The measurement method described is simple and sensitive. It can be used on relatively thick specimens without special preparation and has been found extremely useful in studying the effects of fabrication and processing variables and in separating specimens of varied characteristics for further study. No correlation was found between any of the low field properties and the losses under high fields as measured by the temperature rise. Author

N65-26377# Naval Research Lab., Washington, D. C.
THE EFFECTS OF TECHNIQUE ON THE RELIABILITY OF MECHANICAL IMPEDANCE MEASUREMENT
G. M. Remmers and R. O. Belsheim *In its* Rept. of NRL Progr. Dec. 1964 p 9–28 refs (See N65-26375 15-09)

Results of a recent "Round Robin" mechanical impedance measurement comparison (initiated by the ASA Shock and Vibration Committee) have shown that a great deal of improvement can be made in the reliability of data by better understanding the effects of and paying detailed attention to measurement procedures and techniques. The range of variations reported by nineteen organizations who measured the same test structures is discussed. Specific examples are related to experimental practices, many of which have shortcomings. Factors that require increased attention in order to have increased reliability and repeatability are recommended. Author

N65-26417*# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH IN THE DEVELOPMENT EFFORT OF AN IMPROVED MULTIPLIER PHOTOTUBE Third Quarterly Report
E. H. Eberhardt 28 May 1965 24 p refs
(Contract NASw-1038)
(NASA-CR-63400) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Special developed tubes with 0.35 focusable image sections, a larger first dynode, and a larger defining aperture preceding the dynode were operated under normal conditions of voltage, light intensity, and counting rate, but with a light source modified by the addition of a microscope objective lens so that the small aperture was focused onto the cathode in a few mils diameter spot. Centering of the compound with its light source over a multiplier phototube produced about 100 equidistant scanning points. A good correlation between high and low secondary emission rates was observed, with higher collection efficiencies for secondaries generated near dynode two. Comparison of a normal operations spectrum from a magnesium oxide dynode and a spectrum where dynode one remained at −45 volts indicated that the accelerating field does improve the distribution. Spectra from three cascade aperture tubes operating under −10, 0, and +10 volts showed in two cases marked improvement in the peak-to-valley ratio of distribution. A tube checked with noise divider resistors of pyrolytically deposited carbon film on ceramics had a low total noise count. G.G.

N65-26449# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
SOME APPLICATIONS OF AVALANCHE TRANSISTORS IN HIGH SPEED DISCRIMINATORS
Jozef Kalisz Jan. 1965 15 p refs
(Rept.-593/IA/PH)

A fast discriminator including avalanche trigger circuit with resistance load /delay line/ is described. Applications to the discrimination of the pulses from the scintillation counters and semiconductor particle detectors are presented. Author

N65-26474# Autonetics, Anaheim, Calif.
SOME CONSIDERATIONS ON ESTIMATING THE LIFE OF ELECTRONIC EQUIPMENT DURING ORBIT
D. F. Mc Kenzie 9 Jun. 1964 15 p Presented at the Manned Space Reliability Symp., Am. Astronautical Soc., Anaheim, Calif., 9 Jun. 1964

This Orbiting Space Satellite will orbit nearly circularly at an approximately 260-mi elevation. The orbit will be primarily equatorial with maximum inclination of 29 deg 30 min. Vacuum environment will be approximately 1×10^{-8} mm hg. Radiation will be from two primary sources: the South Atlantic Anomaly and sunbursts. This radiation will be filtered out, except for the electrons, gamma rays, and some spallating soft X-rays. Gamma rays and soft X-ray damage is transient. The electron accelerates the end of life of the electronic semiconductor by build-up of damage. Useful life of the part is a function of electron radiation intensity and time. This paper develops a step-by-step method of determining the useful life of the electronic equipment and the point beyond which the equipment should be completely replaced. Author

N65-26550# Sperry Rand Research Center, Sudbury, Mass.
A STUDY ON P–N JUNCTION PHOTODETECTORS UTILIZING INTERNAL PARAMETRIC AMPLIFICATION Final Report
David E. Sawyer [1965] 139 p refs
(Contract N600(19)-61770)
(SRRC-RR-65-34; AD-464996)

CONTENTS:

1. THE FABRICATION OF EXPERIMENTAL MOLYBDENUM EVAPORATION MASKS C. N. Potter 9 p refs (See N65-26551 15-09)
2. PHOTOPARAMETRIC AMPLIFIER P. Penfield, Jr. and David E. Sawyer 30 p refs (See N65-26551 15-09)

N65-26551 Sperry Rand Research Center, Sudbury, Mass.
THE FABRICATION OF EXPERIMENTAL MOLYBDENUM EVAPORATION MASKS, APPENDIX A
C. N. Potter *In its* A Study on P–N Junction Photodetectors Utilizing Internal Parametric Amplification [1965] 9 p ref (See N65-26550 15-09)

An improved etching technique which allows evaporation masks of high resolution to be fabricated from relatively thick molybdenum foil is described. The masks are for use in contact deposition in the fabrication of experimental semiconductor devices, and have been used at temperatures up to 600° C for forming micro-alloyed contacts to silicon. Mask openings as small as .0004 inch wide ±.00005 inch have been produced. Details of the etching and tungsten carbide scribing operation are given for foil in the .00025 to .0005 inch-thickness range, and for foil .0001 inch thick. As many as 80 grids with consistent widths have been scribed and etched in one mask, by use of these techniques. With molybdenum, the limiting factor in achieving high mask resolution seems to be the grain of the foil. L.S.

N65-26552 Sperry Rand Research Center, Sudbury, Mass.
PHOTOPARAMETRIC AMPLIFIER, APPENDIX B
Paul Penfield, Jr. and David E. Sawyer *In its* A Study on P–N Junction Photodetectors Utilizing Internal Parametric Amplification [1965] 30 p refs Submitted for Publication (See N65-26550 15-09)

This paper compares the spot signal-to-noise ratio of a semiconductor microwave p–n junction photodiode operated as, (1) a simple reverse-biased photodiode, and (2) a photodiode with integral parametric amplification. The gain and noise properties of the photoparametric diode are expressed in terms of the gain and noise of a hypothetical amplifier coupled to the simple (non-parametric) photodiode. For the simple photodiode, the signal-to-noise ratio is an increasing function of the Q of the diode at the signal frequency. For a suitably designed high-Q photodiode, operation as a nondegenerate photoparametric diode, with properly chosen idler and pump frequencies, can yield noise figures for the equivalent hypothetical amplifier as low as a few tenths of a decibel. One advantage of operation as a photoparametric amplifier is that a circulator is not needed. Another is that it is not necessary to pump the diode hard to get gain. In many cases sufficient gain can be achieved for quite low pumping levels, so that many of the instability problems that tend to plague parametric amplifiers are not present. Author

N65-26566# Du Mont (Allen B.) Labs., Inc., Clifton, N. J.
A STUDY OF ELECTRONIC IMAGE MOTION COMPENSATION CONTROL FOR IMAGE AMPLIFIER CAMERAS Technical Report, May 1964–Mar. 1965
John V. Doviak Wright-Patterson AFB, Ohio, AF Avionics Lab., May 1965 232 p refs
(Contract AF 33(615)-1382)
(AFAL-TR-65-103; AD-464171)

Research and development which was conducted during the course of this study program has demonstrated that electronic IMC for an image amplifier camera is feasible and practical. Tests performed on an image amplifier IMC demonstration model show that large magnitudes of image motion can be accommodated, thus permitting long exposure periods. The electronic IMC permits rapid recycling and results in a less cumbersome camera and mounting assembly than is possible with opto-mechanical IMC means. In order to fully realize the advantages deriving from the simplicity of electronic IMC, the image tube employed should not contain any magnetic materials. However, acceptable results can be achieved with image tubes which utilize magnetic kovar seal rings. Author

N65-26571# Mitre Corp., Bedford, Mass.
FABRICATION OF GLASS MASKS, AND THEIR APPLICATION TO THIN-FILM CIRCUIT DEPOSITION
P. Everett and R. Roderick Bedford, Mass., AFSC, Electron. Systems Div., May 1965 25 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-634; W-06760; AD-464486)

This report describes a process which has been developed for the etching of glass masks. A discussion of the requirements for these masks in thin-film circuit deposition precedes a detailed description of the process. Six masks were produced by the process, and measurements were made to determine the tolerances obtained. Author

N65-26627*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS Quarterly Progress Report No. 1, Dec. 4, 1964–Mar. 4, 1965
R. N. Edwards, ed. [1965] 54 p refs
(Contract NAS3-6467)
(NASA-CR-54401) CFSTI: HC $3.00/MF $0.50 CSCL 09A

The design and development of ground prototype ac circuit breakers and dc engine contactors suitable for space environment are continuing. Material for the vacuum interrupter enclosure and contacts, interrupter and actuator design concepts, and facilities for making heat run and endurance tests were selected. Material selection required a solution to outgassing and contact resistance problems. Studies showed that all possible materials would outgas to such an extent that continued scavenging would be necessary. Rodar, thoria dispersed nickel, commercially pure titanium, and arc cast molybdenum were selected. High contact resistance was encountered during interruption tests on the prototype switch. A single pole actuator design for both ac and dc applications was selected. Studies were initiated to determine vacuum interrupter

heat transfer requirements. A vacuum test chamber oven design using quartz lamps as the heat source was selected.
R.N.A.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-25700# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZov: RADIO ENGINEERING, VOLUME VII, NO. 6, 1964
3 Jun. 1965 179 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedeniy, Radiotekhn. (Kiev), v. 7, no. 6, 1964 p 649–770
(JPRS-30395; TT-65-31153) CFSTI: $5.00

Radio transmission and reception: studies of signal and noise properties, oscillator and detector designs. For individual titles see N65-25701 to N65-25721.

N65-25701 Joint Publications Research Service, Washington, D. C.
INCREASING THE EFFICIENCY OF BACKWARD-WAVE AND O-TYPE TRAVELLING-WAVE OSCILLATORS BY MULTI-STAGE REGENERATION
V. P. Taranenko and V. V. Murav'yev *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 1–9 refs (See N65-25700 15-10) CFSTI: $5.00

The numerical solution of non-linear equations is used as a basis for calculating the maximum efficiency of backward-wave oscillators, ordinary and sectionalized travelling-wave tubes with multi-stage regeneration of electron energy at various values of the operating parameters. Author

N65-25706 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE NATURAL FREQUENCIES OF LONG LINES
A. M. Gorinshteyn and L. A. Oganesyan *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 48–57 refs (See N65-25700 15-10) CFSTI: $5.00

A method is developed for separating and calculating the roots of equations which determine the natural frequencies (poles of the transfer ratio) of long lines. The algorithm of the calculation is worked out for use on high-speed digital computers. Author

N65-25708 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE NUMBER OF ELEMENTS IN A GROUP ASSIGNED FOR TEST IN INVESTIGATING FAILURES
G. M. Murzin *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 68–75 refs (See N65-25700 15-10) CFSTI: $5.00

A rule is derived for determining the number of elements in a group assigned for test with the purpose of locating those elements in a system that failed. Most thoroughly is analyzed the case where the probabilities of failure of individual elements are equal. Author

N65-25710 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF A PULSE TRANSFORMER WITH SECTIONS OF COAXIAL LINE
V. V. Kremnev and G. A. Mesyats *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 88–100 refs (See N65-25700 15-10) CFSTI: $5.00

An exact expression is derived for the output voltage of a transformer with coaxial line sections; furthermore, the conditions for transformer matching are determined. Formulae are obtained for maximum slope of the pulse front and for the droop of the pulse top in such a transformer with the cables wound into coils. Author

N65-25712 Joint Publications Research Service, Washington, D. C.
SYSTEMATIC ERRORS DUE TO NOISE IN THE ELECTRONIC-COUNTER FREQUENCY METER
V. P. Zhukov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 113–120 refs (See N65-25700 15-10) CFSTI: $5.00

The systematic errors in an electronic-counter type frequency meter are studied when a sinusoidal signal with Gaussian noise appear at its input. The analysis shows that the magnitude of the systematic error depends on the distribution of the noise spectrum relative to the signal frequency, on the operating level of the shaping device at the meter input and on the resolving time of the electronic counter. Graphs are plotted for easier calculation of the systematic error. Author

N65-25713 Joint Publications Research Service, Washington, D. C.
CONVERTER OF SINGLE PULSE INTO A PERIODICAL PULSE
S. V. Denbnovetskiy, V. G. Abakumov, and A. I. Petrenko *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 121–127 refs (see N65-25700 15-10) CFSTI: $5.00

A device is described which automatically converts a single input pulse into a periodical pulse. The device consists of a storage unit in the form of an attachment for a standard oscillograph. A storage tube records the visual image of the single pulse on a screen. The screen is projected onto a vidicon target on which a potential relief corresponding to the shape of the input signal appears. Discrete values of the recorded input function are read by a scanning method using raster-type sweep. The time interval from the beginning of the vertical line scanning until the appearance of the pulse mark at the instant of the intersection of the potential relief by the electron beam is proportional to the ordinate of the input signal. The output analog voltage, varying in time according to the law of the input signal envelope, is shaped in a special approximation unit of the device. Ordinate values of the pulse at the reading points are represented in the form of a pulse train, in digital or telegraph code. The ordinate reading cycle of the input pulse is repeated periodically so that the reception is provided with a periodic signal on the output of the device. The duration of the pulses generated is determined by the duration of the horizontal reading sweep. R.N.A.

N65-25715 Joint Publications Research Service, Washington, D. C.
ON THE STREAMS OF THE ADJUSTMENTS OF THE PARAMETERS OF RADIO-ELECTRONIC SYSTEMS
V. S. Novikov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 131–136 refs (See N65-25700 15-10) CFSTI: $5.00

A method is described for preventing gradual failures in complex radio-electronic systems. The method is based on the fact that the output parameters of a system are a composition of internal parameters. By properly timed adjustments on the internal parameters, the outer parameters are improved and failures caused by irreversible changes in parameters due to wearing-out, ageing, and maladjustment of the radio-electronic elements are prevented. R.N.A.

N65-25716 Joint Publications Research Service, Washington, D. C.

THE DIRECT COMPONENT OF THE DIODE CURRENT IN THE CASE OF LARGE TRANSIT ANGLES

V. A. Petrov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 137–141 refs (See N65-25700 15-10) CFSTI: $5.00

The direct component of a diode current in the case of large transit angles was investigated. The direct component of the electron velocity, acquired in the interaction with a high frequency field and dependent on the field phase at the instant of the electron escape from the diode, is examined along with thermal velocities in calculating the direct component of the anode current as the chief additional factor in the electron transfer. The average anode current of a vacuum diode serves as a measure of the high frequency field intensity between the electrodes of the diode if the cathode emission current, cathode temperature, and frequency are known; thus making it possible to design meters for measuring the field in a waveguide with these meters operating at very high power levels in the channel. R.N.A.

N65-25717 Joint Publications Research Service, Washington, D. C.

THE EFFECT OF THE FLUCTUATIONS IN THE AMPLIFIER GAIN FACTOR ON THE MEASUREMENTS OF LOW-NOISE SIGNALS

V. V. Yaroshenko *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 142–146 refs (See N65-25700 15-10) CFSTI: $5.00

An experimental investigation on an amplifier channel in the audio-frequency range was carried out with 6K3 and 6N8 tubes which made it possible to obtain data on the spectral density of the amplifier gain factor in the range of 0.04 to 0.5 cycles per second. Harmonic voltage was sent to the input of the amplifier and the effect due to the fluctuations in the amplifier gain factor and modulating the output voltage was analyzed. Fluctuations were investigated for various methods of amplifier power supply. It was found that the experimental data obtained on the spectral power density of the relative changes in the amplifier gain factor are approximated well by expressions of the form $L \times f^{-\alpha}$ where f is the observed value; values for L and α are shown for each method of power supply. J.M.D.

N65-25718 Joint Publications Research Service, Washington, D. C.

CONCENTRATED EXCITATION OF A METALLIC CYLINDER WITH A DIELECTRIC COVER

V. P. Zamarayeva and R. P. Starovoytova *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 147–153 refs (See N65-25700 15-10) CFSTI: $5.00

Excitation of an ideally conducting metallic plane was studied theoretically for the case where the position of the source of excitation is generalized. Equations are developed which show that surface waves with high effectiveness can be excited on a plane with a dielectric cover by means of a concentrated source placed at a determined distance from the plane. J.M.D.

N65-25719 Joint Publications Research Service, Washington, D. C.

SIGNAL-TO-NOISE RATIO ON THE OUTPUT OF A BEAT DETECTOR

B. V. Dvoryashin and V. P. Zhukov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 154–159 refs (See N65-25700 15-10) CFSTI: $5.00

A beat detector circuit arrangement is studied which resembles a standard mixer circuit, differing from it in the respect that the difference frequency does not exceed the passband of the input of an intermediate-frequency amplifier. As a result of this variation, low-frequency components of the noise spectrum reach the output of the filter. Analysis of the beat detector performance indicates that the noise-to-signal ratio on its output may be considerably greater than the ratio for a conventional frequency mixer. J.M.D.

N65-25721 Joint Publications Research Service, Washington, D. C.

ON THE CONVERGENCE OF LAGUERRE EXPANSIONS

S. V. Samsonenko *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 6, 1964 3 Jun. 1965 p 166–173 refs (See N65-25700 15-10) CFSTI: $5.00

A method is developed for choosing parameter values which improve the convergence of the Laguerre expansions of a kind of function widely used in analysis of electronic circuits and signals. The procedure is worked out in the complex plane, using Laplace transforms of the Laguerre functions, since the Laguerre series is a power series in the complex domain. An additional advantage in using the complex plane is that the series can have as its majorant a geometric progression for which the error of the expansion connected with a finite number of the series terms is determined in a simple manner. The results of this analysis are converted back to the real axis. An important application of this method can be the determination of the error in approximation of a correlator using Laguerre linear filters, where the correlator represents an electronic analog of a series for correlation functions. J.M.D.

N65-25763# Space Technology Labs., Inc., Redondo Beach, Calif.

AN INTEGRAL PULSE FREQUENCY ON-OFF ATTITUDE CONTROL SYSTEM

R. L. Farrenkopf, A. E. Sabroff, and P. C. Wheeler 12 Mar. 1963 125 p refs

(Contract AF 04(695)-10)

(STL-8637-6117-RU000; AD-460937)

A complete analytical design procedure is developed for a pulse-frequency on-off attitude control system. In-the-large investigations via an extension of Lyapunov's Second Method establish important ultimate-state boundaries. Analyses establish the existence, stability, and uniqueness of the more important possible ultimate-state limit cycles. Lyapunov techniques are again employed to demonstrate the near equivalence of the pulse-frequency system and its linear first approximation. Analog simulation is employed to complement and extend the analytical investigations. Several important attributes of the pulse-frequency system are investigated and the overall system effectiveness is delineated. Author

N65-25813 Joint Publications Research Service, Washington, D. C.

CORRELATION FUNCTION OF RESPONSE OF MULTICHANNEL ELECTRONIC MULTIPLIER TO RANDOM INPUT

B. G. Marchenko *In its* Cybernetics 9 Jun. 1965 p 184–191 refs (See N65-25800 15-08) CFSTI: $6.00

A theoretical analysis of an electronic multichannel multiplier as an element of an analog computer whose output is the

correlation function of the response to the action of input noise of Gaussian type, is presented. Considered in the analysis are expressions for determining autocorrelation functions for the input filters of the multiplier, the correlation function of the homogeneous polynomial functional with symmetric and asymmetric kernels, and the response correlation function. Speculation is made concerning the use of obtained results for the analysis of coincidence circuits in analog computers, and in radio technology for the analysis of the power law detector. S.C.W.

N65-25815 Joint Publications Research Service, Washington, D. C.

THEORY AND APPLICATION OF ONE METHOD OF ELECTRIC CIRCUIT CONTROL

G. Ye. Pukhov and V. V. Vasil'yev *In its* Cybernetics 9 Jun. 1965 p 211–229 refs (See N65-25800 15-08) CFSTI: $6.00

Presented is a theoretical analysis of a parametric method, whose characteristic feature is the use of the circuit not only for obtaining the error signals, but also for the transformation of error signals to provide a converging control process. The method was developed for solving the problem of the selection of the controlling actions of computing and controlling devices whose elements are electric circuits, so as to make particular points of the circuit potentially null. The proposed method is based on the choice of the voltages of the controlling sources so as to null the source current variations caused by the insertion of variable ohmic or other conductances at the points which must be potentially nulled. The applicability of the method to the design of several devices for analog computers is exemplified. Included is a discussion of several specific methods, which were derived from the proposed theory; and an analysis of the circuits of the parametric models of specific algebraic processes. S.C.W.

N65-25941# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

AN EVALUATION OF AN IMPORTANT ADVANCE IN NETWORK SYNTHESIS THEORY Physical Sciences Research Papers No. 85

E. Folke Bolinder Mar. 1965 27 p refs

(AFCRL-65-172; AD-614600)

A breakthrough in network synthesis theory was accomplished by D. Hazony of the Case Institute of Technology and by D. C. Youla of the Polytechnic Institute of Brooklyn, who independently of each other developed methods for unifying the theory of two-port cascade synthesis. Both methods, based on Richards, theorem, introduce the gyrator artificially but use different methods of proof. A valuable "cookbook recipe" was developed by Youla. Hazony managed to extend the method to n-ports. In all, this epoch-making achievement has resulted in an important, simple method of network synthesis. Author

N65-25991# Case Inst. of Tech., Cleveland, Ohio. Systems Theory Group

A THEORY OF OPTIMALLY AND SUBOPTIMALLY CONTROLLED LINEAR SYSTEMS

Thomas C. Militano [1964] 88 p refs

(Contract Nonr-1141-12; Grant NSF GP-3118)

(SRC-68-A-65-24; AD-612626)

The optimal open loop control policy of a linear discrete deterministic system with respect to an additive quadratic cost functional is derived. Proportional feedback control is postulated and the system is optimized with respect to the same cost functional by choice of reference variables. Necessary and sufficient conditions on the feedback matrix in order that this optimization is equivalent to the open loop optimization are presented. The conditions on the feedback matrix are assumed not to be fulfilled and sufficient conditions for the existence of an optimizing procedure are presented. This procedure is exhibited and shown to result in a non-unique best policy and a suboptimal cost (compared to the open loop optimal control). A second type of suboptimality, that of time selection of control variables, is investigated. Author

N65-26038# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SYMMETRIC TERNARY SWITCHING FUNCTIONS: THEIR DETECTION AND REALIZATION WITH THRESHOLD LOGIC

Roy Dewitt Merrill, Jr. Jun. 1965 74 p refs

(LMSC-6-75-65-29)

One aspect of ternary switching theory and logical design—the detection and synthesis of symmetric functions—is examined. In examining this problem, it was felt that greater insight was gained into the general nature of combinational switching with ternary logic. The usefulness of threshold logic as a means of realizing symmetric functions suggested, as in the binary case, that the approach can be extended in a natural way to the larger class of ternary switching functions. It was recommended that the following areas be given particular attention in future investigations of ternary logic: (1) functions which are symmetric on a subset of their variables; (2) ternary functions of binary and ternary variables; and (3) logical design methods for other than threshold-device realizations. These areas relate directly to the work reported. Investigations of a more general nature should be directed toward establishing in a practical sense, the utility of ternary logic. E.E.B.

N65-26067# Martin Co., Orlando, Fla.

EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS Tenth Quarterly Progress Report, 1 Oct. 1964–1 Jan. 1965

J. J. Gallagher, R. G. Strauch, and R. E. Cupp Apr. 1965 41 p refs

(Contract DA-36-039-SC-90753)

(OR-6386; AD-613473)

The purpose is to investigate the excitation and detection techniques for molecular millimeter wave transitions which can be used to develop a frequency standard operating in the region of 200 to 300 gc. The part concerned with the excitation of molecular transitions is a study of the means of providing a highly stable exciting signal with sufficient power to induce transitions, and an investigation of the resonant structure techniques for exciting the beam. The study of detection techniques covers methods of detecting molecular transitions with provision for using the detected signal for frequency control. The alterations of the molecular beam apparatus, which are required for observation of the Ramsey pattern, have been completed. A new interferometer for the beam apparatus has been completed. A description is given of the changes made in the beam ionization system. The distortions of line shapes which are anticipated at millimeter wavelengths are discussed. Author

N65-26111# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

THE ANALYSIS AND DESIGN OF INTENTIONALLY NONLINEAR FEEDBACK CONTROL SYSTEMS Final Report

R. F. Drenick 27 Aug. 1964 14 p refs

(Grant DA-ARO(D)-31-124-G144)

(PIBMRI-1237-64; AROD-1538-30; AD-613715)

The research was developed along four main lines of study: (1) Synthesis of low-sensitivity control systems; (2) optimal control systems; (3) linear equivalents for nonlinear feedback systems; and (4) stochastic theory of feedback control. Efforts resulted in the following conclusions and ideas for future research: the ideas of game theory and statistical decision theory

are being brought to bear on the problem of sensitivity (uncertainty); efforts at connecting modern control theory with modern control practice are being followed by recent ideas in which the controlled system is again assumed linear but with randomly varying parameters; the concept of optimality of a control system is being compromised in two directions: (1) solutions must be sought which are insensitive to changes in the assumptions made; and (2) economically realizable systems must be aimed for. TAB

N65-26126# Harry Diamond Labs., Washington, D. C.
A RADIATION-TOLERANT VCO FOR HIGH-G APPLICATIONS
Joel S. Cohen 23 Feb. 1965 16 p refs
(HDL-TR-1279; AD-615270)

A mathematical analysis of a voltage-controlled tunnel-diode oscillator is described. The oscillator is designed to function after experiencing a 25,000-g environment as well as a neutron flux density of 10^{14} neutrons/sq cm. The oscillator circuit is inherently stable over a wide temperature range but requires a regulated voltage. It can be designed to meet the Inter-range Instrumentation Group telemetry standards. Author

N65-26175# Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NO. 1, 1965
8 Jun. 1965 305 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Tekhn. Kibernetika (Moscow), no. 1, Jan.–Feb. 1965 p 3–200
(JPRS-30473; TT-65-31188) CFSTI: $7.00

Papers are presented on pattern recognition, message coding and transmission, learning systems, classifications and discrimination, and cybernetic devices with certain optimal features. For individual titles see N65-26176–N65-26201.

N65-26180 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF CONDITIONS OF RELIABLE REALIZABILITY OF THRESHOLD FUNCTIONS IN REAL THRESHOLD ELEMENTS
M. B. Gendler *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 47–62 refs (See N65-26175 15–10) CFSTI: $7.00

The present work which is a further generalization of works [1, 2] is devoted to determination in the general form of conditions of reliable realizability of given threhold functions by real threshold elements which have ideal threshold characteristics, unstable weights and threshold, and at the input of which in place of binary variables the unstable physical variables corresponding to them are supplied. Author

N65-26190 Joint Publications Research Service, Washington, D. C.
ANALYTICAL CONSTRUCTION OF A REGULATOR FOR STABILIZATION OF A LINEAR SYSTEM WITH RANDOM DELAY
G. A. Agasandyan *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 171–182 refs (See N65-26175 15-10) CFSTI: $7.00

The problem of construction of a control effect to stabilize a system, the object of control of which is described by differential equations with a delay argument, is investigated. It is assumed that the delay is a Markov discontinuous process. The control is selected from the condition of minimum average integral quadratic error. Author

N65-26191 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF ANALYSIS OF THE CURRENT SPECTRUM OF A SIGNAL OF A PARAMETRIC CURVE OF A SELF-TUNING SYSTEM
G. V. Malyshev and I. N. Pechorina *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 183–189 refs (See N65-26175 15-10) CFSTI: $7.00

An analysis of the operation of a sensitive element of one of the classes of self-tuning systems is presented. The concepts of current spectrum and instantaneous power spectrum are used. The derivation is presented of an expression relating the current spectra of signals at the input and output of a sensitive element. Author

N65-26192 Joint Publications Research Service, Washington, D. C.
DEFINITION OF REGIONS OF STABILITY OF PULSE EXTREMAL SYSTEMS WITH MODULATION BY ANALYSIS OF THE PARAMETRIC OSCILLATIONS
A. A. Tunik *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 190–207 refs (See N65-26175 15-10) CFSTI: $7.00

A pulse extremal system (PES) of a different type is investigated for different systems of replacement of the objects. The method of A. Leonard developed for continuous linear systems is modified and used for analysis of stability of the PES. The conditions of stability of the free and forced movements of the PES are obtained. Author

N65-26193 Joint Publications Research Service, Washington, D. C.
IMPROVEMENT OF THE NOISE PROOFING OF A ONE CLASS AUTOMATIC SYSTEM USING NONLINEAR CONTROL LAWS
V. A. Zemskov and B. M. Makar'yev *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 208–219 refs (See N65-26175 15-10) CFSTI: $7.00

The problem of improvement of noiseproofing of control systems using specially introduced nonlinear functional circuits is investigated. It is shown that on the basis of the method of harmonic linearization those nonlinear control laws may be selected for which the noiseproofing of systems of the investigated type with respect to harmonic noises is significantly improved by comparison with the usual linear control. Author

N65-26195 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF SELECTION OF AN OPTIMAL STRUCTURE OF A DIGITAL AUTOMATIC CONTROL SYSTEM WITH RESPECT TO THE CRITERION OF THE TSYPKIN MAJORANT GOING TO A MINIMUM
M. A. Dukhovnyy and E. G. Faynshteyn *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 232–236 refs (See N65-26175 15-10) CFSTI: $7.00

Using the linear law of prediction, the structure of a digital criterion of the Tsypkin majorant going to a minimum is derived. Making special assumptions about the representation of the continuous input signal selection of a solution which could bring the majorant to a minimum is sought. The laconic algorithm for finding the minimum function is used. An example is given which shows that an infinite set of digital automatic control systems exists for which the Tsypkin majorant assumes the least value. Limitations are given for which the problem of selection of an optimal structure in the indicated sense for a digital automatic control system may be generalized. N.E.A.

N65-26196 Joint Publications Research Service, Washington, D. C.

THE OPTIMAL PROBLEM OF A "HIT" IN NONSTATIONARY LINEAR SYSTEMS

Nguyen Tkhan'bang *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 237–248 refs (See N65-26175 15-10) CFSTI: $7.00

On the basis of the maximum principle of Pontryagin a solution is presented for the problem of a "hit" in non-stationary linear systems which are optimal in the integral sense. A procedure is shown for using electronic simulators in the solution of this problem. Two examples are considered.

Author

N65-26198 Joint Publications Research Service, Washington, D. C.

ON A PROBLEM OF OPTIMAL CONTROL

Ye. Ya. Roytenberg *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 270–277 refs (See N65-26175 15-10) CFSTI: $7.00

For a control system (an electric motor) which is under the influence of external forces on the basis of the Pontryagin maximum principle an algorithm is developed for determination of the control which maintains transition of the system in a minimum possible time to the condition of quasi stationary motion in which the value of the angular velocity of rotation of the shaft of the electric motor is stabilized. The algorithm developed does not require information about the present position of the system in the phase space, and is realized only on the basis of information about the initial state of the system.

Author

N65-26199 Joint Publications Research Service, Washington, D. C.

OPTIMIZATION OF VALUES OF TRANSFER COEFFICIENTS AND DETERMINATION OF SCALES FOR OPERATION ON ELECTRONIC MODELS

V. L. Veyts and L. G. Shrago *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 278–287 refs (See N65-26175 15-10) CFSTI: $7.00

In this work the problem is solved of determination of transfer coefficients of decision elements and scales of representation of variables for simulation of different systems on electronic simulators. An algorithm is developed for finding the transfer coefficients eliminating in contrast to the usual trial and error method used for this purpose the arbitrariness in selection of values and optimizing of the solution of the problem.

Author

N65-26200 Joint Publications Research Service, Washington, D. C.

ON A PROCEDURE FOR OBTAINING RANDOM NUMBERS WITH A UNIFORM LAW OF DISTRIBUTION

I. A. Ushakov *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 288–294 ref (See N65-26175 15-10) CFSTI: $7.00

For obtaining of random numbers with a uniform distribution the properties of Poisson flow are used. Several block diagrams are presented which realize the given procedure.

Author

N65-26218# Joint Publications Research Service, Washington, D. C.

ON CODING THEORY AND SELF-ADJUSTING SYSTEMS

8 Jun. 1965 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 3, 1965
(JPRS-30482; TT-65-31193) CFSTI: $1.00

CONTENTS:

1. ON AN ARITHMETIC FUNCTION HAVING APPLICATION IN CODING THEORY R. R. Varshamov p 1–5 refs (See N65-26219 15-10)

2. ON INVARIANCE OF SEARCH-FREE SELF-ADJUSTING SYSTEMS WITH A MODEL R. R. Varshamov p 6–10 refs (See N65-26220 15-10)

N65-26219 Joint Publications Research Service, Washington, D. C.

ON AN ARITHMETIC FUNCTION HAVING APPLICATION IN CODING THEORY

R. R. Varshamov *In its* On Coding Theory and Self-Adjusting Systems 8 Jun. 1965 p 1–5 refs (See N65-26218 15-10) CFSTI: $1.00

The arithmetic function $k_{n,q(z)}$, which is of significance in coding theory and cybernetics, is defined by an equation. A relationship has been shown between the function and some special asymmetrical correction codes. Numerous propositions and proofs are presented.

M.W.R.

N65-26220 Joint Publications Research Service, Washington, D. C.

ON INVARIANCE OF SEARCH-FREE SELF-ADJUSTING SYSTEMS WITH A MODEL

R. R. Varshamov *In its* On Coding Theory and Self-Adjusting Systems 8 Jun. 1965 p 6–10 refs (See N65-26218 15-10) CFSTI: $1.00

Equations are presented in detail for a search-free, self-adjusting system with a model, to insure stability and high quality of control when varying the parameters. Under certain conditions, the error between the output coordinates of the system and the model is shown to be constant with the control effects. It is concluded that this permits a new approach when selecting the structure of the system to be used.

M.W.R.

N65-26621# Library of Congress, Washington, D. C. Aerospace Technology Div.

PRODUCING POWERFUL RADIO PULSES BY THE ELECTRIC EXPLOSION OF METAL WIRES [POLUCHENIYE MOSHCHNYKH RADIOIMPUL'SOV PRI POMOSHCHI ELEKTRICHESKOGO VZRYVA METALLICHESKIKH PROVOLOK] Translations of Soviet-Bloc Scientific and Technical Literature

2 Jun. 1965 11 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 1, 1965 p 132–137
(ATD-T-65-35; AD-464629)

An impact excitation of a parallel oscillating circuit connected in series with wires exploded by a high density current is investigated. Copper and silver wires are used as switching elements. Given a discharge potential of 4.5 to 7 kV and a storage capacity of 0.58 to 0.77 μf, weakly damped oscillations are generated during the current pause, characterized by currents of the order of 10^2 to 10^3 amp within the frequency range from 2.6 to 29 Mc/sec. The dependences of initial excitation amplitude on the number and the diameter of the exploding wires, on the discharge potential, and on the natural frequency of the circuit show that the initial amplitude increases with a decrease in wire diameter, and decreases with an increase in frequency according to a law close to $1/\omega^2$. The measurements show that when the circuit is shunted with a 39-ohm resistance, its quality factor decreases from 80 to 17, and a maximum current in resistance reaches 150 amp. A comparison of the data proves that the initial amplitude increases with a decrease in inductance of the discharge circuit because of the increased portion of the usable magnetic energy of the discharge circuit.

R.W.H.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-25608 Joint Publications Research Service, Washington, D. C.
RECONSTRUCTION OF THE METEOROLOGICAL STATION AT THE SOUTH POLAR OBSERVATORY MIRNYY
V. M. Sklyarov *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 40–48 (See N65-25603 15-20) CFSTI: $4.00

Construction of a new meteorological station, the Mirnyy Observatory on the Pravda Coast in Antarctica, is described briefly. The guiding principles for construction were based on unfortunate experiences with an unsuccessful observatory in the same area. The main problems discussed are location of a site that would ensure representativeness and uniformity of observations under weather conditions which are extraordinarily severe even for the Antarctica, the placement of duralumin tubes as support for numerous instruments, the construction and support of meteorological enclosures which can be rotated about their vertical axes, and the establishment of a new service building for the observatory. J.M.D.

N65-25778# Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.
RAPID SITE PREPARATION FOR TURBOJET VTOL AIRCRAFT Technical Documentary Report, 1 Oct. 1963–31 Aug. 1964
J. E. Butler and G. F. Thomas Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 108 p refs
(Contract AF 33(651)-1092)
(APL-TDR-64-125; AD-613342)

A sprayable, rapid-curing, light-weight, low-cost material system for use as a remote landing and takeoff site for turbojet VTOL aircraft was developed. The material system was composed of a chlorinated polyester resin, modified with temperature resistant additives and fiber glass reinforcement. The capabilities of the material system were demonstrated by testing in the direct exhaust of an afterburning J85-GE-5 turbojet engine and by an operational field site used for repeated take-off and landings of an X-14A jet VTOL aircraft. The material system withstood temperatures up to 3000° F for short periods. The basic VTOL landing site area exposed to the severe temperatures and velocities of a jet engine exhaust can be fabricated using a maximum of 2.5 lbs./ft.^{2}. Author

N65-25789# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
DEVELOPMENT OF AN ABSTRACT MODEL FOR AEROSPACE MAINTENANCE SYSTEMS Final Report
Charles M. Riehl, John P. Van Blarcom, Claire B. Schneider, and Ralph J. Ceci, Jr. Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 9 Mar. 1965 347 p
(Contract AF 33(615)-1330)
(SID-64-2172; AFAPL-TR-64-150; AD-612905)

Development and operation of a digital computer model capable of simulating aerospace maintenance systems is described. Model scope is concerned with both prelaunch maintenance activity, performed to prepare an aerospace system for launch, and postlaunch maintenance activity performed during the mission. Distinct submodels were developed for each phase. The model routines are written in SIMSCRIPT program language to enable model application to a variety of aerospace programs. Model flow patterns are generally deterministic, with allowances for disruptive events caused at random times by hardware malfunctions. The model is assigned to produce predictive output information regarding the operation and efficiency of the maintenance system during the time period of interest and for its contribution to the aerospace program in terms of schedule fulfillment. Author

N65-25920# RAND Corp., Santa Monica, Calif.
GROWTH OF AUTOMATION IN PRELAUNCH CHECKOUT FOR SPACE VEHICLES
Larry T. Mast Apr. 1965 14 p refs Presented at IEEE Tech. Conf., St. Louis, 7–9 Jun. 1965
(P-3111; AD-614410)

An analysis of the potential of increased automation in the factory-to-launch space vehicle preparation sequence, is presented. Emphasized is the feasibility of using automation in data reduction, telemetry buffering and limit checking, monitoring discrete signals, fuel control, trend analysis, go–no-go system tests, emergency prediction, communication, countdown, system performance estimations, verifying paperwork and hardware data, fault isolation, and control flexibility. A discussion of hypothetical methods for deriving estimates of equipment characteristics implied by specific tasks, and for deriving the programing requirements necessary in implementing the tasks, is included. S.C.W.

N65-25969*# Technical Research Group, Inc., East Boston, Mass.
[DESIGN OF FREE SPACE ROOMS TO IMPROVE ELECTRICAL PERFORMANCE] Final Report
29 Jan. 1965 43 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951100)
(NASA-CR-63335; TRG-245) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Theoretical and experimental investigations were carried out to determine if the incorporation of certain features in the design of free space rooms would improve their electrical performance. These rooms are to be used for measurements of high performance and generally low gain antennas. The investigated features for incorporation in the design of free space rooms included the use of absorbers, longitudinal baffles, transverse irises, pyramidal back walls, and tilted back walls. The results of the study on these features are presented. N.E.A.

N65-25971*# National Aeronautics and Space Administration. Marshall Space Flight Center.
NASA'S 150-METER METEOROLOGICAL TOWER LOCATED AT CAPE KENNEDY, FLORIDA
John W. Kaufman and Lester F. Keene 12 May 1965 20 p
(NASA-TM-X-53259) CFSTI: HC $1.00/MF $0.50 CSCL 04B

This report describes the basic functional operations of the 150-meter NASA Meteorological Tower Facility located in the Merritt Island Launch Area, Cape Kennedy, Florida. Meteorological instrumentation and data acquisition schemes for obtaining lower atmospheric profile measurements of temperature, winds, and humidity are discussed. Specific information on such matters as meteorological sensor response, electronic circuitry of the meteorological facility, and explicit details of recorder systems has purposely been omitted. Author

N65-26018# Toronto Univ. (Ontario). Inst. for Aerospace Studies
APPLICATION OF A JET PUMP AND COANDA SURFACE TO VENTILATION OF A HIGHWAY TUNNEL
Y. Nishimura Feb. 1965 108 p refs
(UTIAS-TN-82)

An experimental investigation of a scale model of the Welland Canal Tunnel was undertaken to determine the feasibility of two-way jet pump ventilation of a highway tunnel employing the Coanda effect. The jet sheet is injected normally through an opening in the ceiling. An adjacent quarter-round "Coanda surface" turns the sheet so as to flow parallel to the ceiling. A small shift of the primary nozzle toward a mirror-image "Coanda surface" reverses the direction of the jet sheet along the ceiling. Various nozzle configurations were tested to determine the size of the nozzle best suited for the ventilating system. The test program included probing the primary jet sheets and secondary induced flows and determining the average velocity of the ventilating flow. A gas analysis technique made it possible to determine the combined effects of traffic and wind on the ventilating flow. Furthermore, measurements were made to determine whether there are problems of carbon monoxide recirculation in the tunnel and of flow reversal time in designing a control system for the ventilating system. The investigation has yielded gratifying results and has indicated that the utilization of the Coanda effect for jet pump ventilating is workable and attractive. Author

N65-26024*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics

DEVELOPMENT OF A SPECTROSCOPIC SHOCK TUBE

M. H. Miller and T. D. Wilkerson Apr. 1964 48 p refs

(Grants NsG-359; AF-AFOSR-141-63)

(NASA-CR-63379; BN-353) CFSTI: HC $2.00/MF $0.50 CSCL 20D

We describe a gas-driven shock tube and associated equipment to be used for radiative transfer experiments in the Institute for Fluid Dynamics and Applied Mathematics, University of Maryland. This report covers the design and construction of the tube and its inital operation to check out the hydrodynamic behavior. Various devices measure the flow properties. We achieve temperatures up to 15,000° K, for periods up to 300 microseconds, in the stationary gas behind the reflected shock wave. These conditions allow meaningful reduction of emission spectra to absolute line strengths for many elements of astrophysical interest. Other radiative transfer problems will also be studied. We discuss preliminary spectroscopic work and the instruments now being built for time-resolved spectroscopy. Author

N65-26173# Honeywell, Inc., West Covina, Calif. California Ordnance Center

A STUDY OF OPTICAL SYSTEM CONCEPTS AND HIGH INTENSITY LIGHT SOURCES FOR SOLAR RADIATION SIMULATION

Halbert Fischel (Messinger Consultants Co.) and Roger R. Hughes Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, May 1965 426 p

(Contract AF 40(600)-1069)

(H-6152-19; AEDC-TR-65-117; AD-461018)

The study described herein has been made to evaluate three new high-powered arc sources as possible radiation sources for a large modular solar simulator. From data supplied by Arnold Engineering Development Center (AEDC), the radiation characteristics of the sources have been studied to determine the spectral properties of the radiation from each source, and to permit derivation of mathematical expressions for the radiance distribution of each source. A careful review of the nature of solar radiation and of the theory of energy transfer in optical systems has been conducted. On the basis of this review and the source radiance functions derived in the source study, several optical system concepts for solar radiation simulation have been synthesized and analyzed for use with each source. The optical concepts studied range from simple parabolic collimators and uncollimated projection modules to systems consisting of trains of conic section reflectors and modifications thereto. Author

N65-26235# Army Missile Command, Huntsville, Ala. Inertial Guidance and Control Lab.

THE ARMY'S NEW INERTIAL GUIDANCE AND CONTROL FACILITY

Charles E. Riley 8 Mar. 1965 58 p refs

(RG-TR-65-9; AD-464175)

The purpose of this report is to identify and describe the special features and equipment provided in the Army's new Inertial Guidance and Control Laboratory located at Redstone Arsenal, Alabama. In addition to functioning as the Army's primary in-house research and development facility for missile inertial guidance and control, the laboratory also acts as the Army's Inertial Guidance Management and Technology Center, with responsibility for coordinating and providing technical and program support to all Army research and development on inertial systems and components used for guidance, navigation, stabilization, and control. Highlighted in the report are design and tradeoff studies of various types of clean room and isolation platform designs leading to the selection of specific designs for incorporation into the new facility. In addition, operation, control, and maintenance procedures of the clean room area are outlined to show the importance of these factors in achieving a required level of contamination control in an area devoted exclusively to inertial component and system research, development, assembly, and testing. Author

N65-26265# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Raumsimulation

SIMULATION OF SPACE ENVIRONMENT COMPONENTS [DIE SIMULATION DER UMGEBUNGSKOMPONENTEN DES WELTRAUMETS]

A. Kalt Jan. 1965 65 p refs In GERMAN; ENGLISH summary

(DLR-FB-65-02; DVL-378) Available from Zentralstelle für Luftfahrtdokumentation und Information (ZLDI), Munich: 15, 40 DM

The demand for space simulation is briefly discussed; and the characteristics of the essential environmental components are outlined. This is followed by a discussion of possibilities and practicability of simulating these components. The possibilities for constructing space simulation equipment for the most important environment components are then described. This report also includes information on construction tendencies in the development of space simulation facilities. Author

N65-26276# Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Technology Div.

ROTARY TRANSFORMERS FOR OPERATION IN HIGH VACUUM

Marshall K. Kingery (M.S. Thesis., Tenn. Univ.) May 1965 136 p refs

(AEDC-TR-65-82; AD-464017)

This report presents a theoretical and experimental investigation of the feasibility of the rotary transformer to transmit power across a moving interface in high vacuum. Cooling of the transformer by radiation to the LN_2-cooled walls was studied on a small, open-frame transformer. Since ordinary radiation alone is not sufficient to cool the transformer for higher power units, LN_2 cooling was investigated and found to be technically simple. Nomographs were prepared showing thermal radiation and temperature extremes with all major variables shown as parameters. Based on data from evaluation of the temperature problem, preliminary design criteria were developed for a rotary transformer which can transmit power to a gimbal-mounted test vehicle in a space chamber at pressures of 10^{-5} torr and lower. The possibility of using a three-phase wound rotor motor is discussed in theory. Author

N65-26344# Princeton Univ., N. J.
RESEARCH ON DIELECTRIC PROPERTIES AND THE STRUCTURE OF MATTER Quarterly Status Report, 1 Oct.–31 Dec. 1964
Charles P. Smyth [1964] 6 p
(Contract Nonr-1858(09))
(QSR-35; AD-612916)

A new apparatus for the measurement of the dielectric constants and losses of low-loss liquids at 2-mm wavelength has been set up. Toluene was measured first, since accurate data were available for this substance at millimeter wavelengths. Results turned out to be in excellent agreement with these data. Measurements on pure chlorobenzene showed that this apparatus also gave accurate values of dielectric constant and loss of medium loss liquids. TAB

N65-26349# New Hampshire Univ., Durham. Dept. of Mechanical Engineering
DESIGN OF EQUIPMENT FOR PROPAGATION OF SHORT STRESS PULSES IN RODS OF VISCOELASTIC MATERIAL
Mayo Carrington, Jr. (M.A. Thesis) Jun. 1964 56 p refs
(AD-608340)

The behavior of polyethylene, a viscoelastic solid exhibiting time-dependent effects not found in usual engineering structural materials, was studied under conditions of dynamic loading. The response functions representing velocity and displacement at selected lengths of a polyethylene rod were determined by the stress pulse initiated by detonation of explosives at one end of the rod. The corresponding displacement at the other end was measured by a variable capacitance transducer. Curves representing the profile of particle velocity vs time for stress pulses after travelling through 12, 22, and 32-inch long rods, 1/2-inch in diameter are given. These curves represent the slope of the time–displacement records produced by the variable capacitance transducer. The dispersion of a pulse by the viscoelastic medium is clearly shown by the time duration increase. E.E.B.

N65-26414*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RESISTOJET RESEARCH AND DEVELOPMENT, PHASE II Third Quarterly Progress Report, 1 Jan.–31 Mar., 1965
Richard D. John 10 Jun. 1965 130 p refs
(Contract NAS3-5908)
(NASA-CR-54330; AVCO-RAD-TR-65-13) CFSTI: HC $4.00/MF $1.00

Continued research and development of electrothermal thrustor systems of the resistance type in the 5 to 5000 power range are reported. An operational wire-in-tension thrust stand and an operational impulse table are described. The thrust stand and impulse table have respective sensitivities of ±5 and ±1 micropounds. Thrust data obtained on a simple 5 millimeter diameter orifice indicate that the ratio of actual to ideal specific impulse is between 0.60 to 0.70 in the thrust range from 10^{-5} to 10^{-4} pounds. The model I single-axis resistojet attitude control system, including thrustors, a propellant storage and feed system, control logic, signal and power conditioning package, and an on-board position sensor, was successfully operated on an air bearing facility. Operation of the system was demonstrated in the acquisition mode, and in both soft and hard limit-cycle operation. R.N.A.

N65-26462# Royal Aircraft Establishment, Farnborough, (England).
THE DEVELOPMENT OF SLOTTED WORKING SECTION LINERS FOR TRANSONIC OPERATION OF THE N.A.E. 3-FOOT WIND TUNNEL
E. P. Sutton (Natl. Aeron. Estab.) London, Min. of Supply, Mar. 1955 41 p refs
(RAE-AERO-2536)

The development of removable slotted liners to extend the range of the National Aeronautical Establishment 3-foot supersonic wind tunnel to transonic speeds is described. They are mounted within the existing working section on the two sides, enclosing shallow outer chambers between their slotted surfaces and the original side walls. At all speeds there was originally a pronounced streamwise pressure gradient, associated with reversed flows in the outer chambers. It was almost eliminated by the addition of perforated screens behind the slots to suppress turbulent mixing there. Author

N65-26479 Oak Ridge National Lab., Tenn.
LOW-TEMPERATURE LIQUID INFRARED ABSORPTION CELL
H. W. Morgan, P. A. Staats, and R. G. Steinhardt (Hollins Coll.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 15–16 refs (See N65-26475 15-24)
CFSTI: $6.00

A low-temperature liquid cell was constructed by modification of the conventional sealed infrared cell. It was repeatedly cycled through the range 300° to 77° K by various liquids at their boiling or freezing points and maintained at fixed intermediate temperatures for extended periods. The liquid cell is formed by a gold-foil space pressed between two circular windows. The cell is cooled by conduction, the housing being a part of the base of a thin-walled stainless steel Dewar. The Dewar mounts in a vacuum jacket with two infrared transmitting windows. To minimize radiation loss and to prevent corrosion, all parts of the cell other than the windows and stainless steel are gold plated. The cell has operated reliably and is simple to assemble and disassemble for cleaning or modification. Spectra were recorded of liquid CH_4, C_2H_6, and other hydrocarbons, as well as liquid BF_3 and solutions of BF_3 in liquid Xe. E.E.B.

N65-26583# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
VADEMECUM 1964
Aug. 1964 17 p refs

Wind tunnels, free flight-model test facilities, laboratory aircraft and flight test equipment, equipment for testing structures and materials, test beds for solid and liquid propellant propulsion, environmental test facilities and calibration equipment, and computers of the National Aeronautical and Astronautical Research Institute, Netherlands are described. R.N.A.

N65-26598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY STUDY OF HIGH-TEMPERATURE SYNTHETIC-AIR HEATER FOR USE WITH A MACH 8 TO 9 HYPERSONIC TUNNEL
Erwin A. Lezberg, Steven A. Zlatarich, and Harold G. Price, Jr. Jun. 1965 20 p refs
(NASA-TN-D-2878) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Calculations and preliminary experiments have demonstrated the feasibility of a synthetic-air heater that could be used to supply heated air to a Mach 8.5 hypersonic test facility with true flight temperature and pressure simulation. The heater concept involves mixing strongly heated nitrogen and preheated nitric oxide and utilizing the exothermic decomposition of the nitric oxide to increase the mixture temperature. Calculations of the heat released because of the reaction of nitric oxide in a pebble-bed preheater and preliminary experiments of its decomposition in a packed bed have shown that the nitric oxide can be heated to 1300° K without excessive decomposition. Calculations of the high-temperature decomposition of nitric oxide-nitrogen mixtures have shown that the reaction time is about 0.4 millisecond and probably will be controlled by mixing considerations. Nitrogen was heated to temperatures approaching 3000° K in a small graphite pebble bed without any significant

formation of cyanogen. Recommendations for future work include the investigation of design and operational changes to extend the operational life of the graphite susceptor and experimental studies of the mixing and reaction of hot nitric oxide and nitrogen. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-25551 Northrop Corp., Hawthorne, Calif. Norair Div.
CURRENT STATUS OF RESONANCE THEORY OF TRANSITION
G. S. Raetz *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 1-54 refs (See N65-25550 15-01)

An improved form of the resonance theory of transition is described. For simplicity, mainly a boundary layer generated on a flat wall by an unaccelerated flow of an incompressible fluid is considered. Also, mostly simple irregularities at the wall surface and in the adjoining flow are assumed as the conditions causing transition. The main features of the resulting motion are deduced from the continuity and Navier-Stokes equations in this deduction, the whole motion first is decomposed into a basic flow, chosen as the laminar flow occurring in the absence of the boundary irregularities, and a sequence of perturbation flows. The basic flow satisfies a nonlinear but solvable differential system, whereas the perturbation flows all satisfy inhomogeneous linear differential systems. The theory offers a possible way of estimating transition motions and related phenomena, including the introduction of disturbances by boundary irregularities and perhaps certain properties of turbulence. Some aspects of such calculations as well as some generalizations of the theory to other flows are discussed. Author

N65-25552 Northrop Corp., Hawthorne, Calif. Norair Div.
EXACT NUMERICAL SOLUTION OF THE COMPLETE LEES-LIN EQUATIONS FOR THE STABILITY OF COMPRESSIBLE FLOW
W. Byron Brown *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 55-67 refs (See N65-25550 15-01)

A numerical solution of the Lees-Lin equations has been described and used to compute the neutral stability curves for two series of flat plate profiles from M = 0 to M = 5.0. The two series are those whose velocity and temperature profiles have been previously published. In the first series, the stagnation temperature of the air stream was taken as 100° F, appropriate to many wind tunnel experiments. In the second series, the freestream static temperature was taken as −67° F, appropriate to high flying airplanes. In addition, some calculations have been made for M = 5.8 to compare with data previously published. Another series of experiments was carried out at M = 5.8. In order to compare these results with the theoretical solutions, velocity and temperature profiles were computed for this case. It is concluded that to a Mach number of about 1.6, the Lees-Lin equations agree very closely with observed stability data in both upper and lower branches of the neutral stability curve. From there up to 5.8, neutral stability calculations with the Lees-Lin equations agree well with experimental data for the lower branch of the neutral curve. The calculations do not agree with the data in the upper branch. N.E.A.

N65-25554 Northrop Corp., Hawthorne, Calif. Norair Div.
INCOMPRESSIBLE CROSSFLOW STABILITY CALCULATIONS WITH VARIOUS ANGLES OF THE WAVE FRONTS WITH THE POTENTIAL FLOW DIRECTION
W. Byron Brown *In its* Sum. of Laminar Boundary Layer Control Res., Vol. I Mar. 1964 p 73-95 ref (See N65-25550 15-01)

The suction profiles on a swept wing close to the wing trailing edge have been computed and used, in turn, to compute four neutral stability curves. Among these four, the transverse profile has the lowest value for the critical Reynolds number. The curves show that both the critical Reynolds number and the range of wave numbers in which amplification is possible depends on ϵ, which measures the direction of the profile plane. It is concluded that the critical Reynolds number computed from the transverse boundary layer profile at a station close to the trailing edge of a swept laminar suction wing is within about ten percent of the lowest value for any plane profile. N.E.A.

N65-25561 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section
INVESTIGATION OF A LAMINAR FLAT PLATE WITH SUCTION THROUGH MANY FINE SLOTS WITH AND WITHOUT WEAK INCIDENT SHOCK WAVES. LOW DRAG BOUNDARY LAYER SUCTION EXPERIMENTS ON A FLAT PLATE AT MACH NUMBERS 2.5, 3.0, AND 3.5
E. E. Groth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 428-441 (See N65-25560 15-01)

Low drag boundary layer suction experiments on a 41-inch long flat plate were conducted at the 40- by 40-inch continuous supersonic Tunnel A of the Arnold Engineering Development Center at Tullahoma, Tennessee. The model was equipped with 76 closely spaced, fine slots arranged in eight suction chambers. Full length laminar flow was obtained at M = 2.5, 3.0 and 3.5 up to the highest possible tunnel pressures, resulting in length Reynolds numbers of 21.8×10^6, 25.7×10^6 and 21.4×10^6, respectively. The measured drag coefficients (sum of wake and suction drag) were of the order of 26 to 43 percent of the turbulent friction drag at the same Reynolds and Mach numbers. The results of calculations of the laminar boundary layer development along the plate at typical suction distributions are compared with the test data. Author

N65-25562 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section
BOUNDARY LAYER SUCTION EXPERIMENTS ON A SLOTTED FLAT PLATE MODEL WITH INTERFERING SHOCK WAVES
E. E. Groth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 442-448 (See N65-25560 15-01)

The interaction of an impinging shock wave with the laminar boundary layer was investigated at the AEDC Tunnel A on a 41-inch chord flat plate suction model by mounting a plate (shock generator) vertically on the suction model. The shock wave intersected the suction slots in the rear half of the model under an acute angle. The flat plate model and its suction system were the same ones which were used previously for shock-free low-drag measurements. Laminar flow was maintained aft of the shock wave up to certain intensities depending on Mach and Reynolds number. The increases in suction quantities and total drag as function of the shock intensity were measured at Mach numbers between 2.5 and 3.5 and Reynolds numbers up to 26×10^6. Author

N65-25563 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section
LOW DRAG BOUNDARY LAYER SUCTION EXPERIMENTS AT SUPERSONIC SPEEDS ON AN OGIVE CYLINDER WITH 29 CLOSELY SPACED SLOTS

E. E. Groth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 449–463 (See N65-25560 15-01)

Low drag boundary layer suction experiments on an ogive cylinder were conducted at the Arnold Engineering Development Center supersonic Tunnel E-1 at Tullahoma, Tennessee, at Mach numbers 2.5, 3.0 and 3.5. The model had the same external dimensions as the one tested in 1958, but was equipped with an improved suction system. A larger number of closely spaced slots approached continuous suction to a better degree, and larger suction tubes permitted higher suction coefficients. Full laminar flow and drag coefficients were measured up to Reynolds numbers $R_L \sim 15 \times 10^6$ at $M = 2.5$, $R_L \sim 12 \times 10^6$ at $M = 3.0$ and $R_L \sim 7 \times 10^6$ at $M = 3.5$. The boundary layer development along the body was computed for several experimental suction and surface pressure distributions and the results were compared with the test data. Author

N65-25568 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

PRESSURE DROP IN LAMINAR FLOW TUBES WITH COMPRESSIBLE FLOW

W. Pfenninger and K. H. Rogers *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 548–550 (See N65-25560 15-01)

The pressure drop for laminar flow in a circular tube of 0.244-inch inside diameter and 11.3-foot length was measured for several inlet Mach numbers M_o at different reservoir pressures p_k. The pressure ratio p/p_k is presented versus the nondimensional tube length x/RR_R for various inlet Mach numbers. With increasing values of M_o and x/RR_R the density and static pressures decreased rapidly until choking occurred at the downstream end of the test tube at pressure ratios $p/p_k \cong 0.20$ to 0.25. These pressure ratios at choking are considerably lower than for one-dimensional potential flow in a tube. Boundary layer measurements at the downstream end of the test tube for choked conditions showed supersonic flow in the center and subsonic flow toward the wall of the tube with an average Mach number of approximately one. The highest length Reynolds number with full length laminar flow was $\bar{U}_o x_E/\nu_o = 26.1 \times 10^6$ at $M_o = 0.430$. Author

N65-25642# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering

UNCONVENTIONAL METHODS FOR INFLUENCING FLUID FLOW Final Report; Part I—Acoustic Pumping, Oct. 1962–Sep. 1964

James L. Mc Elroy (Ph.D. Thesis) Wright-Patterson AFB, Ohio, AFSC, Feb. 1965 125 p refs
(Contract AF 33(657)-9914)
(AFAPL-TR-64-133, Pt.-1; AD-613641)

Equations describing the properties of an arbitrary fluid subjected to periodic disturbances are developed. A method of solution is proposed involving the Fourier expansion of the unknown functions to an arbitrary approximation, which solves the problem of acoustic streaming between parallel plates. The solutions obtained yield new information but reduce to previous solutions if identical assumptions are made. Solutions of the two dimensional wave equations with dissipation are obtained by means of algebraic manipulation of the equations with a digital computer program. The retention of thermal conduction is shown to have significant effect on the resulting solutions. Results of the streaming calculations are applied to a possible acoustic absorption pump. Significant pumping outputs are calculated but predicted efficiencies are very low The relation between an acoustic pump and a jet pump is discussed. Another variant of acoustic pump, the resonant cavity pump, is discussed qualitatively. The pumping mechanism is the rectifying effect of a nozzle or orifice on the periodic flow between the resonant cavity and an infinite reservoir. The pump is of reasonably high efficiency but limited to low outputs. Author

N65-25760# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics

TURBULENT TRANSPORT PROPERTIES FOR AXISYMMETRIC HETEROGENEOUS MIXING Interim Report

Victor Zakkay, Egon Krause, and Stephen D. L. Woo Wright-Patterson AFB, Ohio, ARL, Mar. 1964 91 p refs
(Contract AF 33(616)-7661)
(PIBAL-813; AD-460970)

The turbulent mixing of two dissimilar gases for both subsonic and supersonic flows was carried out to determine the turbulent transport coefficients for hydrogen-, helium-, and argon-air mixtures in the mixing region of two coaxial jets. The basic differential equations describing the mean flow properties are solved for the transport coefficients. The convective derivatives needed in the solution of the equations are determined from the velocity and concentration profiles measured in the experiments. Values of the eddy viscosity, turbulent diffusion coefficient, and Lewis number were evaluated in this manner; the eddy viscosity obtained was compared with existing formulations. A new formulation for the eddy viscosity is given, whereby existing theories may still be used in analyzing the mixing process. Finally, the influence of similar velocity and concentration profiles on the transport properties is discussed and similarity parameters in both axial and radial directions are shown to be valid for various injected gases. Author

N65-25781# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

A METHOD FOR CALCULATING THE INTERACTION OF A BOW SHOCK OF A RE-ENTRY VEHICLE AND A BLAST WAVE

Thomas D. Taylor Feb. 1964 19 p refs
(PA-TR-3152; AD-612733)

A general technique for computing the transient flow field in the nose region of a blunt body traveling at hypersonic speeds after head-on interception by a shock wave is presented. The method is not limited to the assumption in previous investigations that the density, pressure, and velocities are constant in the interaction region. The technique can be applied to compute the flow in the entire interaction region, but is discussed for computing the flow near the axis of symmetry. Author

N65-25818# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

TECHNIQUES FOR SOLVING NONEQUILIBRIUM EXPANDING FLOW PROBLEMS Interim Technical Report

Robert E. Mates and John A. Lordi Wright-Patterson AFB, Ohio, ARL, Jan. 1965 37 p refs
(Contract AF 33(657)-8860)
(ARL-65-2; AD-614457)

The solution of nonequilibrium nozzle flows involves the numerical integration of a set of nonlinear ordinary differential equations. Difficulties are encountered in starting the solution since the flow is initially in equilibrium. The starting technique used at CAL is based on a perturbation about the equilibrium solution. Several perturbation methods are compared. A method is presented for mixing the equilibrium and nonequilibrium equations which is useful for systems involving widely different reaction rates. Improvements in the numerical integration technique, including the application of a recent modification of the Runge-Kutta method, are discussed. These improvements reduce oscillations in the solutions and reduce computing time. It is shown that substantial reductions in

computing time are possible by starting the solution as far downstream as possible. The solutions obtained do not depend on the starting point. Author

N65-25857# Oklahoma State Univ., Stillwater. School of Mechanical Engineering
DECONTAMINATION OF HYDRAULIC FLUIDS AND DYNAMIC HOSE STUDY Technical Report, Jan. 1964–Jan. 1965
Wright-Patterson AFB, Ohio, Systems Engineering Group, Jan. 1965 71 p refs
(Contract AF 33(657)-9958)
(SEG-TR-64-74)

The installation of the prototype hydroclone on standard hydraulic test stands as a means of upgrading the decontamination capabilities in USAF ground support equipment is described. The acquisition of hydraulic fluid samples from the field installations and the laboratory tests of these samples are discussed along with a comprehensive technical comment on the results of the various analyses. A comparison of filtration performance of the hydroclone and the final filter presently being used on the hydraulic test stands is presented. Studies on field test units were conducted to determine the maintainability, compatibility endurance limits, reliability, and service life of the hydroclone and its critical components. A recommended test procedure is presented for the verification of hydroclone performance and the establishment of qualification requirements for quantity production. General design criteria curves for optimum hydroclones are given which can be used to design a hydroclone, using MIL-F-5606 hydraulic fluid, to separate specific sizes and densities of various contaminants found in USAF ground support equipment. A unique method for the dynamic testing of high pressure hose assemblies and the cleaning of new hose assemblies is presented, along with the contaminant generating characteristics of high pressure hoses constructed of various materials. Author

N65-25869# Gt. Brit. Dept. of Scientific and Industrial Research. National Engineering Lab.
THE PRESSURE GRADIENT DUE TO FRICTION DURING THE FLOW OF BOILING WATER
D. Chisholm Mar. 1963 16 p refs
(NEL-78)

Equations are developed, using the Martinelli correlating group, for the prediction of the pressure gradient due to friction during the flow of boiling water. Author

N65-25907# Hydronautics, Inc., Laurel, Md.
COLLAPSE OF TURBULENT WAKES IN DENSITY-STRATIFIED MEDIA
Jin Wu Jan. 1965 44 p refs
(Contract Nonr-3688(00))
(TR-231-4; AD-612482)

The wake generated by a submerged body moving through a density-stratified medium consists of a region of turbulence and a region of water with homogeneous density. The present research studied phenomena and modeling criteria relating to the collapse of this wake. Since the wake is very slender in the direction of the body passage, this problem is simplified by studying only the collapse of a particular transverse section of the wake. An experimental technique was developed by using a wall-mixer to model the collapsing phenomenon of a two-dimensional wake in density-stratified media. The process of collapse can be divided into initial, principal, and final stages. Empirical formulae have been derived to describe the collapse processes of the first two stages, during which the gravitational effect is found to be the predominant modeling criterion. The collapsing process in the final stage was complicated by the increasing viscous effect and observed mixing at the thin wake tip. Author

N65-25921# Illinois Univ., Urbana. Dept. of Physics
GREEN'S FUNCTIONS AND SUPERFLUID HYDRODYNAMICS
Joseph W. Kane and Leo P. Kadanoff [1964] 42 p refs
(Contract Nonr-1834(12))
(AD-614044)

A study of the nonequilibrium behavior of superfluid systems using the techniques of thermodynamic Green's functions, is presented. Included are approximations for condensate wave functions $\langle\Psi(1)\rangle$ and the single particle Green's function; real time equations of motion to slow space and time variation; gauge transformation equations for an analysis of rapid variation; a procedure for obtaining local thermodynamic equilibrium solutions to the Boltzmann equation; local equilibrium solutions for deriving the two fluid hydrodynamic equations; and an outline of a procedure which can be applied to derive the hydrodynamic equations as the response of the single particle Green's functions to an external field. A comparative analysis of existing theories concerning the question of superfluid liquid hydrodynamics is also included. S.C.W.

N65-25938# Naval Ordnance Lab., White Oak, Md.
ON THE HYPERSONIC SHARP LEADING EDGE PROBLEM FOR BODIES OTHER THAN FLAT PLATES
Jay M. Solomon May 1965 64 p refs
(NOLTR-65-8; Aerodynamics Res. Rept.-241; AD-614627)

The flow near the tip of pointed-nosed bodies in hypersonic flight is considered; particularly, the region where continuum concepts are applicable, but where boundary layer theory is no longer valid, for the flat plate problem. Both two-dimensional and axially symmetric bodies are considered. Solutions are obtained in the form of expansions valid near the nose tip. The surface pressure is found to approach a finite value as the tip is approached; numerical results for this limit value are obtained for various wall to total temperature ratios and tip semivertex angles. Author

N65-26057# General Applied Science Labs., Inc., Westbury, N. Y.
APPROXIMATE ANALYSIS OF FREE MIXING FLOWS
Seymour L. Zeiberg and Brent Kaplan 27 Aug. 1964 16 p refs
(Contract NOw-63-0637-c FBM)
(TM-112; AD-460903)

Presented is a refinement of a linearized solution to boundary layer equations, which is based upon the combined methods of streamwise coordinate stretching and pointwise collocation of a linearized solution. In the technique, the momentum integral equation is used to stretch the radial coordinate, while the differential equation is used to stretch the streamwise coordinate. Comparative results of an illustrative calculation with an exact numerical solution are included, which are in complete agreement with the proposed theory. Also included are results for the linearized solution, the solution with only streamwise coordinate stretching, and the solution with both streamwise and radial coordinate stretching. The applicability of the technique to some types of three-dimensional steady and unsteady wake flows, is cited. S.C.W.

N65-26060# General Applied Science Labs., Inc., Westbury, N. Y.

AN INVERSE SOLUTION FOR AN AXISYMMETRIC BOUNDARY LAYER PROBLEM

Gdalia Kleinstein and Michael Abbett 6 Aug. 1964 54 p refs
(Contract NOw-63-0637-c FBM)
(TR-442; AD-460872)

An inverse solution is suggested for the determination of the geometry of a surface as well as the flow field for problems where displacement thickness effects on the inviscid flow are no longer negligible. For a given data line extending from a point on the surface to the shock, and with the pressure as the only parameter, an inviscid calculation can be performed which establishes the flow field all the way down to an edge streamline, the geometry of which is also determined. The modified inviscid calculation utilized here permits one to compute the edge streamline in a region possessing a small but nonzero shear. The information generated along the edge streamline together with the initial data between the surface and the edge streamline, is sufficient to solve the viscous flow problem (within the boundary layer approximations) in the finite region which exists between the edge streamline and the surface. The viscous flow problem yields the surface geometry as part of the solution. Analytical considerations are employed in order to indicate the method while numerical techniques are utilized in the solutions of specific problems. Results presented (which are of a preliminary nature) indicate good agreement with other numerical methods using the direct approach. Possible extensions and adaptations of the method to other problems of practical interest like boundary layer flows with external vorticity and the base flow pressure are also indicated. Author

N65-26099# Mississippi State Univ., State College. Dept. of Aerophysics

A STUDY OF JET EJECTOR PHENOMENA

Chia-An Wan Nov. 1964 61 p refs
(Contract Nonr-978(03))
(RR-57; AD-613485)

It is suggested that the mixing process within a jet ejector is an interchanging of momentum and energy among each stratum of the flow field. As soon as the ambient air is entrained into the ejector, the interchanging of momentum and energy occurs. Particles or groups of particles in the flow field which have possessed less momentum and energy will receive some amount of external momentum and energy, and on the other hand, particles or groups of particles which are at higher energy and momentum level will lose some. A discussion of the structure of the flow field in the inlet length of the ejector, centerline velocity of the ejector, velocity profile at the outlet of the ejector, and velocity ratios and augmentation factor is presented. N.E.A.

N65-26120# Kaman Aircraft Corp., Colorado Springs, Colo.

HEAD-ON INTERACTION OF SHOCK FRONTS AND BOW WAVES OF RE-ENTRY VEHICLES

Belmont S. Evans and Louis E. Bothell 3 Mar. 1965 75 p refs
(Contract NOsp-64021-c)
(KN-65-43(R); AD-614666)

A method using equations of state for air data is outlined for calculating shocks produced by head-on interaction of a shock front with the bow wave of a reentry vehicle. Shock conditions on both sides of each atmospheric discontinuity were computed. The use of a computer program permitted calculation of the data directly rather than by graphical interpolation. These results illustrate that the density in the reflected shock varies with equation of state conditions rather than either shock strength or R/V velocity. Through the use of statistical techniques, a closed form expression was developed to predict initial interaction pressure to within ±8% for altitudes, blast shock strengths, and R/V velocities. Data are presented for ambient atmospheric conditions; reflected shock, ambient, and bow wave conditions at various altitudes; and variables as a function of blast overpressure and R/V velocity. M.W.R.

N65-26165 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SEPARATION MEASUREMENTS IN BINARY SPECIES GASEOUS VORTEX FLOWS AND FLOW VISUALIZATION STUDIES IN A WATER VORTEX

T. J. Pivirotto and E. J. Roschke *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 237–250 refs (See N65-26150 15-22) CFSTI: $7.00

A gaseous-core nuclear reactor propulsion concept is reviewed, some of the major fluid dynamics problems associated with the concept are discussed, and results of the experimental binary separation and flow visualization studies are presented. In the vortex concept, a binary mixture of gases which have significantly different molecular weights is introduced tangentially into a cylindrical container at its periphery. Both fluids spiral inward; however, the fluid of greater molecular weight forms into a rotating annular cloud as a result of the forces introduced by the rotation. Ideally this cloud would be retained within the container, and the light fluid would diffuse radially inward toward the cloud and be discharged through an orifice in the end wall. Once the cloud of heavy fluid has been formed, injection would be limited primarily to the light gas. In a propulsion device the gas of high molecular weight would be the nuclear fuel and the gas of low molecular weight would be the propellant. E.E.B.

N65-26166 Aerospace Corp., Los Angeles, Calif.

VORTICES AND VORTEX MATRICES

Martin L. Rosenzweig and Steve Lewellen *In* Los Alamos Sci. Lab. Proc. of An Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 251–285 refs (See N65-26150 15-22) CFSTI: $7.00 $7.00

The theoretical and experimental work on the flow dynamics of vortex flows are discussed. The theoretical effort was aimed at solving the Navier Stokes equations for a flow model of a vortex in a container. The fundamental equations are given. One important point obtained from these equations is the fact that flow in strong vortices always tries to be uniform in the axial direction, i.e., the flow tends to be two dimensional. A simple two-dimensional solution obtained from the equations for the main part of the flow outside of any shear zone is discussed. This solution and the solution for the flow in the boundary layer are used to derive the solution of the interaction problem between the primary flow and the boundary layer. On the experimental work, flow-visualization studies are described. E.E.B.

N65-26238# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science

WEAK WAVES IN RELAXING FLOWS

Peter P. Wegener, Boa-Teh Chu, and W. A. Klikoff, Jr. Mar. 1965 34 p refs
(Contract Nonr-609(46); Proj. Defender)
(AD-464314)

Theoretical and experimental investigations are described of the linearized wave equation of supersonic flow with a single relaxation process. Firing range experiments using a known model gas mixture with a single relaxation process are discussed. Qualitatively, it is shown that weak conical and spherical waves decay as predicted by theory. In addition, this decay can be determined quantitatively for conical disturbances; and satisfactory agreement with theory is found. For applicatio

to unknown relaxation processes, it is suggested that observation of the damping of weak waves provides an additional tool for the study of fast rate processes. Author

N65-26266# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Proz (West Germany). Inst. für Angewandte Gasdynamik
THE BEHAVIOR OF PERIODICALLY GENERATED SHOCK WAVES IN A CONICAL TUBE [DAS VERHALTEN PERIODISCH ERZEUGTER STOBWELLEN IN KONISCHEN ROHREN]
R. Koch Jan. 1965 40 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-03; DVL-377) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 11.10 DM

Experimental investigations were performed on the behavior of shock waves of high frequencies in a conical shock tube. The waves were generated by periodical combustion of an air/petrol mixture. The pressure distribution along the tube walls was studied at different initial pressures; the velocity and the influence of the reflected wave on the ignition of the injected mixture have been investigated in detail. The test results were compared with measurements performed on a single wave. Author

N65-26267# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (West Germany). Institut für Angewandte Gasdynamik
INTERACTION EFFECTS OF LATERAL CONTROL JETS EXPANDING INTO A SUPERSONIC FLOW. EXPERIMENTAL AND ANALYTICAL INVESTIGATION WITH SLOT-NOZZLES OF FINITE LENGTH [INTERFERENZWIRKUNGEN SEITLICH AUSTRETENDER GASFORMIGER STEUERSTRAHLEN BEIUBERSCHALLANSTROMUNG. EXPERIMENTELLE UND ANALYTISCHE UNTERSUCHUNGEN BEI VERWENDUNG VON SCHLITZDUSEN ENDLICHER LANGE]
F. Maurer Jan. 1965 86 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-04; DVL-382) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 21.70 DM DM

Experimental and analytical investigations are presented in this paper concerning flowfields resulting from a gaseous control jet expanding laterally from slot-nozzles of finite length into a supersonic main flow. The experimental work is restricted to the expansion of cold air into a wind tunnel flow over a flat plate. The experimental results include pressure distributions, normal force coefficients, schlieren- and surface-oilflow pictures. These results provide a basis for developing a flow model for an analytical approximation. The calculated results, when compared with the measurements, show the influence of the different parameters and help to better understand the flow interaction processes. Author

N65-26287# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
RADIATION AND SCATTERING OF TRANSIENT GRAVITY WAVES BY VERTICAL PLATES
C. C. Mei Feb. 1965 39 p refs
(Contract Nonr-220(35))
(E-97.8; AD-462770)

Some initial value problems are studied regarding the radiation and scattering of gravity waves by thin vertical plates in an infinitely deep ocean. The general solution is obtained by transforming the boundary value problem to one of the Riemann-Hilbert type. Explicit investigations are made for the large time behavior of the free surface elevation for the case of a rolling plate, and for the Cauchy-Poisson problems in the presence of a stationary plate. By taking the limit as $t \to \infty$, the steady state solution is derived for a harmonic point pressure acting on the free surface near a vertical barrier. Author

N65-26294# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
AN EXPERIMENTAL STUDY OF LAMINAR NEAR WAKES
E. P. Muntz and E. J. Softley Apr. 1965 68 p refs
(Contracts AF 04(694)-474; AF 04(694)-486)
(R64SD8; AD-614004)

The near wakes of a 0.05 nose bluntness ratio, 10° half angle sphere cone have been investigated. Direct measurements of static temperatures and densities were obtained between the body base and four base diameters downstream. The results indicate that the near wake static temperatures are sensitive functions of both Reynolds number and model surface temperature, but not of Mach number. Wake static temperatures decrease with increasing Reynolds number. The temperatures also decrease with decreasing wall temperature. Nose bluntness effects on wake temperatures have been studied experimentally. For 0.05, 0.23 and 0.3 nose bluntness ratio 9° and 10° half angle sphere cones the maximum temperatures in the wakes increased with increasing nose bluntness ratio. Measurements of base pressure and heat transfer have also been obtained. The base pressure ratio (P_b/P_∞) increased with increasing bluntness, increasing Mach number and decreasing Reynolds number. The base heat transfer when correlated in terms of base flow parameters was found to be insensitive to variations in bluntness ratio, Mach number and wall temperature. Also, it was only weakly dependent on Reynolds number. Author

N65-26371# General Applied Science Labs., Inc., Westbury, N. Y.
ESTIMATES OF THREE-DIMENSIONALITY, UNSTEADINESS AND RATE CHEMISTRY IN THE WAKE OF AN OSCILLATING REENTRY VEHICLE
Brent Kaplan 30 Sep. 1964 74 p refs
(Contract NOw-63-0637-c)
(TR-461; AD-461610)

A highly simplified model of a three-dimensional unsteady wake shed by an oscillating reentry vehicle is considered. Approximate solutions for the non-linear regime of the wake are presented in closed form for the axis variables and for the principle wake thicknesses as functions of time and streamwise distance. Only simplified chemistry is considered, i.e. frozen, equilibrium or a perturbation from the frozen solution. For the cases considered it appears that three-dimensionality, per se, has relatively little influence on the instantaneous distribution of axis variables. The major effect of vehicle oscillations upon streamwise distributions of the wake variables is caused by the attendant variation of the wake initial conditions due to changing angle of attack. Streamwise oscillations are seen to be far-wake effects. At the lower altitudes attachment reactions reduce the level of electron density in the far wake so that these oscillations are not in evidence. Author

N65-26443# General Electric Co., Evendale, Ohio. Advanced Engine Technology Dept.
INVESTIGATION OF HYPERSONIC INLET SHOCK-WAVE BOUNDARY LAYER INTERACTION
Paul H. Kutschenreuter, Jr., James S. Keith, James A. Weil, and Paul H. Nettleton Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Mar. 1965 329 p refs
(Contract AF 33(675)-11747)
(AFFDL-TR-65-36; AD-464057)

The effects of hypersonic shock wave boundary layer interaction from a secondary shock system on supersonic hypersonic combustion inlet performance were investigated. A computational procedure was established for estimating laminar boundary layer flow properties through impinging shock induced laminar boundary layer interactions including regions of

separated laminar flow. Boundary layer separation characteristics for 5 different compression model configurations were obtained. Comparisons were favorable between measured and theoretical laminar and turbulent heat transfer rates through the shock boundary layer interaction region. Methods were improved for estimating inlet leading edge shock shape when considering viscous and bluntness interaction. The hypersonic speed investigations in air and helium resulted in an extension of earlier correlations of laminar boundary layer separation pressure plateaus to higher Mach numbers. Favorable agreement with free interaction separation is indicated based on boundary layer edge conditions determined from continuity considerations for the helium data. Data comparisons for air were less favorable. R.N.A.

N65-26467# Royal Aircraft Establishment, Farnborough, (England).
NOTE ON THE POSSIBILITY OF RAINDROPS BEING SHATTERED BY THE AIR DISTURBANCES CAUSED BY A MOVING BODY
D. C. Jenkins London, Min. of Supply, Oct. 1957 38 p refs
(RAE-TN-ME-239)

The possibility of raindrops being shattered by the air disturbances caused by a moving body is considered in relation to the air flow conditions imposed on the drops and the conditions necessary to cause shatter. The limited data available are applied to some cases corresponding to aircraft flight in rain. This analysis suggests that disintegration of some of the drops may be well advanced before they reach the aircraft surface. Author

N65-26563# ARO, Inc., Arnold Air Force Station, Tenn.
THE NONEQUILIBRIUM EXPANSION OF A DIATOMIC GAS THROUGH A CONVERGENT-DIVERGENT NOZZLE
Max Kinslow and J. T. Miller Arnold Eng. Develop. Center, Jun. 1965 23 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-103; AD-464533)

This report is addressed to the problem of predicting the flow properties of a high temperature gas expanding through a hypersonic nozzle. The basic equations for the conservation of mass, momentum, and energy are applied to the one-dimensional flow of an inviscid, adiabatic gas with finite vibrational relaxation and dissociation recombination rates. These equations are integrated exactly, where possible, to give an integral equation containing only temperature and the parameters of the lagging processes, vibrational energy, and mass fraction of atoms. Together with the rate equations, which are integrated, these equations are solved by an iteration technique on a digital computer for the flow through a hypersonic nozzle starting from any initial condition. A condition is also found which must be satisfied at a critical point near the minimum area of the nozzle. This critical point then serves as a starting point in the nozzle from which conditions both upstream and downstream can be determined. These basic methods are applied to calculate the flow properties along the nozzle of an arc-heated, low-density, hypersonic wind tunnel operated with nitrogen gas. The calculations are in substantial agreement with measurements. Author

N65-26619# Library of Congress, Washington, D. C. Aerospace Technology Div.
MIXING OF CONCENTRIC HIGH-VELOCITY AIR STREAMS, COMPILATION OF ABSTRACTS Surveys of Soviet-Bloc Scientific and Technical Literature
25 May 1965 26 p
(ATD-P-65-33; AD-464635)

Abstracts of articles dealing with published Soviet research on the subject of mixing of concentric high velocity airstreams are presented. Area covered include: (1) turbulent air jets heated to 4000° K; (2) turbulent wake and jet in a concurrent stream in the presence of the longitudinal pressure gradient; (3) a turbulent isothermal jet in a concurrent flow; (4) numerical calculation of high temperature laminar jets; (5) calculation of a non-cylindrical mixing chamber; (6) mixing of gas streams; (7) the influence of initial turbulence on the boundaries and range of submerged jets; (8) the theory of a differential ejector; (9) hypothesis on the generalization of ejection characteristics of turbulent gas jets and its application; and (10) thickness of the turbulent mixing zone on the boundary of two streams of gases of different velocities and densities. N.E.A.

N65-26641*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINING THE VELOCITY OF AN AVERAGE-SIZE CONDENSATE DROP IN A FLOW OF SATURATED VAPOR [K OPREDELENIYU SKOROSTI SREDNERAZMERNOY KAPLI KONDENSATA V POTOKE NASYSHCHENNOGO PARA]
I. P. Faddeyev Jun. 1965 8 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (USSR), v. 4, no. 9, 1961 p 56-60
(NASA-TT-F-364) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Theoretical considerations on determining the velocity of condensate drops in a flow of saturated vapor are given, based on the example of the efficiency of a turbine stage operating in the wet-steam range. Equations of motion for a condensate drop, derived by various authors, are compared, showing a large discrepancy in the values obtained at a pressure of 1.033 atm and a temperature of 100° C. Special experimental work is recommended. Author

N65-26645*# California Univ., Los Angeles.
KINETIC THEORY APPROACH TO THE STUDY OF A CURVED SHOCK-WAVE
M. M. Oberai Washington, NASA, Jun. 1965 21 p refs
CFSTI: HC $1.00/MF $0.50
(NASA-TN-D-2858)

Mott-Smith method is extended to derive the first order—counting Rankine-Hugoniot relations as the zero order—shock relations for a curved shock-wave formed in a flow when the Reynolds number is not very large. The role of the additive constant that occurs in the solution of the zero order shock-wave structure is discussed. Also, solution of the first order shock-wave structure is obtained. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-25581# Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.
GRAVITY DISTURBANCE COMPONENTS FROM A SPHERICAL HARMONIC EXPANSION OF THE DISTURBING POTENTIAL

S. Louis Decker Apr. 1965 22 p refs
(ACIC-TP-18; AD-613956)

The solution of the basic "differential equation of gravimetry" is the disturbing potential, T. Gravity disturbance components in a local orthogonal coordinate system are obtained from the gradient of T where T is expressed in spherical coordinates r, ϕ, λ. Gravity disturbance components in rectangular earth-centered, earth-fixed and earth-centered, inertial reference systems are provided by a coordinate transformation.
Author

N65-25589*# Princeton Univ., N. J. Dept. of Geology
A VISCOUS MODEL OF THE EARTH COMPARED TO GRAVITY ANOMALIES AND SEISMIC REFRACTION PROFILES OF OCEANIC TRENCHES AND RIDGES Report No. 2
W. Jason Morgan 30 Apr. 1965 79 p refs
(Grants NsG-556; NSF GP-1450)
(NASA-CR-63244) CFSTI: HC $4.00/MF $0.75 CSCL 08J

The effects of both a sphere and a cylinder sinking beneath the surface of a fluid of uniform viscosity were examined. The state of the fluid at the surface is described by the horizontal velocity and the shear stress (v_x and F_{xz}), and the vertical velocity and the normal stress (v_z and F_z). If the top surface is a free surface, the depression h of the surface above the sinker is related to the vertical force through the formula $F_z = \bar{\rho}gh$. It is found that F_z is independent of the viscosity of the fluid and the boundary conditions of the top surface. A free surface or rigid plate gives the same F_z. When a model with two layers of fluid was examined, it was found that F_z was relatively independent of the thickness of the top layer or the ratio of the two viscosities. The viscous model was then used to interpret oceanic trenches and mid-ocean ridges. The horizontal features are very dependent upon the assumed viscosity pattern, the vertical load F_z is not. The approximate mass of the sinker and its depth beneath the surface may be independent of the viscosity pattern of the earth. The vertical surface load F_z was related to the thickness of the crustal layers. The variations in the crustal thickness give rise to gravity variations, which, plus the attraction of the deep sinker, were interpreted as the net free air anomaly. The crustal thickness ($\propto F_z$) and the free air anomaly computed for sinkers of different sizes and depths were compared to the measured free air anomalies and seismic depths of the Puerto Rico Trench and Mid-Atlantic Ridge. In both of these cases the driving mass had an optimum depth of about 100 kilometers. Author

N65-25610 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE MOISTURE RESERVES IN THE SNOW COVER BY AN AIRCRAFT GAMMA SURVEY
R. M. Kogan, M. V. Nikiforov, Sh. D. Fridman, V. P. Chirkov, and A. F. Yakovlev *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 58–67 refs (See N65-25603 15-20) CFSTI: $4.00

Four methods are described for determination of moisture content in a snow cover based on the use of gamma radiation of natural radioactive elements in the soil beneath it. In the first method the total intensity of the gamma field in the air is measured from aircraft at two different times, giving the reserve of water accumulating during the interval between flights. The second measurement also involves repeated observations, in which measurements are made of certain monochromatic components of natural gamma radiation. The third method consists of a single measurement of the ratio of two monochromatic components of gamma radiation of any isotope. In the fourth method there is a single observation of the angular components of gamma radiation. The methods are said to be productive, satisfactorily accurate, and they will yield sufficiently complete information on snow reserves over large areas for relatively small expenditures. J.M.D.

N65-25631# Smithsonian Astrophysical Observatory, Cambridge, Mass.
METEOR GEOMAGNETIC EFFECTS
Sydney Chapman (Alaska Univ.) and Attia A. Ashour (Cairo Univ., UAR) Washington, Smithsonian Inst., 1965 20 p refs *Its* Contrib. to Astrophysics, V. 8, No. 7, 1965 p 181–197 GPO: $0.20

A review and discussion of various studies on meteor magnetic effects is presented. It was found that these effects are probably induced by variations of the Sq ionospheric currents, which are much stronger by day than by night. The meteor magnetic effect depends on the inclination of the meteor's trajectory, on the angle it makes with the direction of the Sq current flow, and the height of the trajectory; its growth is determined mainly by the speed of the meteor which governs the date of formation of the trail. Very strong Sq currents of the equatorial electrojet at hours around 11 a.m. offer the best area for observable meteor effects. G.G.

N65-25676# Uppsala Univ. (Sweden). Geodetic Inst.
RESEARCH ON METHODS OF DETERMINING LEVEL SURFACES OF THE EARTH'S GRAVITY FIELD Final Report, 1 May 1959–30 Apr. 1964
Erik Tengstrom and Andreas Vogel [1964] 66 p refs
(Contract AF 61(052)-226)
(AFCRL-65-95; AD-613012)

Level surfaces of the earth's gravity field and their secular variations are studied. The theoretical possibility of determining refraction by measuring the dispersion angle between rays of visible light with different wave lengths is considered. Two instruments, called interferodispersometers, for measuring such dispersion angles have been designed. A method of determining geoidal deflections, including geoidal connections over open sea-areas and medium distances, is described. An extrapolation method for the upwards continuation of gravity and deflections, which has been applied up to 50 km above sea-level, is discussed. The problem of an eventual secular variation of gravity, due to the dynamical properties of the outer core, was studied. Author

N65-25687# Naval Research Lab., Washington, D. C.
DETERMINATION OF RADON CONCENTRATION IN THE AIR THROUGH MEASUREMENT OF ITS SOLID DECAY PRODUCTS Interim Report
L. B. Lockhart, Jr., R. L. Patterson, Jr., and C. R. Hosler (U.S. Weather Bureau) 29 Mar. 1965 30 p refs
(NRL-6229; AD-613943)

An analytical method was devised for the determination of the radon concentration in the air by measurement of the radioactive decay of the solid radon daughters collected on air filters during a fixed sampling period. The ratio of the radioactivity present at two periods, determined by an initial count immediately after termination of sampling and a second count an hour later, was used to estimate the extent of radioactive equilibrium established between radon and its daughters and to obtain a correction factor for relating daughter to radon activity. The disintegration of the various decay products of radon, as a function of the age of the radon conglomerate, were calculated during the growth and collection periods and for successive 5-minute decay periods extending through the first 71 minutes following termination of filtration. A procedure for the calibration of β counters for the evaluation of RaB and RaC activities was established. This method was used to determine radon concentrations in the air near ground level. Author

N65-25735# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIATION PROCESSES IN STRATIFORM CLOUDS (CHAPTER I, SECTION 5 AND CHAPTER II, SECTIONS 1–7)

Ye. M. Feygel'son 19 Mar. 1965 92 p Transl. into ENGLISH of the book "Radiatsionnyye Protsessy v Sloistoobraznykh" Moscow, 1964 p 59–65, 69–119

(FTD-MT-65-48; AD-613465)

A very rough model of the absorption spectrum of a cloudless atmosphere based on approximations of the transmission functions is presented, that takes into account the regions with large, average, and small coefficients of absorption. It was found that the dispersing properties of the atmosphere at 5 km altitude differ by not more than 30% to 50%. A survey of theoretical work on the scattering of light in clouds includes the two-flux approximation, diffusion approximation, asymptotic representation of the flux, semiempirical theory, and numerical solutions of the equations of transfer for a large and an elongated indicatrix of scattering. G.G.

N65-25753# Aerospace Corp., El Segundo, Calif. Electrical and Optical Dept.

INFRARED HORIZON SENSOR ACCURACY IN THE ATMOSPHERIC ABSORPTION BANDS

M. D. Earle Jun. 1964 41 p refs

(Contract AF 04(695)-269)

(TOR-269(4540-80)-3; AD-460971)

Atmospheric radiance data, computed by the Weather Bureau based on a variety of atmospheric models, were analyzed. Narrow spectral regions, located within the carbon dioxide absorption band centered at 15 microns, were considered. A spectral band approximately 1.7 microns wide centered very close to the absorption band shows promise of providing 1σ horizon sensor accuracies of about 0.05°. A two-color technique involving the use of two spectral regions in the vicinity of the CO_2 absorption band is discussed. The use of the 28.6 to 40.0 micron spectral region within the broad rotational water vapor absorption band is considered. Author

N65-25756# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

MEASURING IONIC MOBILITIES IN THE MESOSPHERE

Quarterly Progress Report, 1 Aug.–31 Oct. 1964

H. Dolezalek 5 Nov. 1964 45 p

(Contract DA-19-020-AMC-0058(X))

(QPR-6, AD-461024)

Theoretical considerations and experimental work are presented in a continuing study on the measurement of ionic mobilities in the mesosphere. The theory of current measurements as a consequence of charge movements in a Gerdien chamber, and the necessity of measuring the tangential impact of these charges are discussed. Signal amplification from the receiving electrodes is considered. Calculations were continued on the resolution of the modified Gerdien chamber and on the ion loss in the ion gate. A new wind-tunnel housing was built, and the tunnel itself was redesigned to include an independent regulation of wind speed and pressure, an airstream smoothing section, and a baffling section to prevent air-motion feedback. The Baratron differential pressure gage was modified to allow simultaneous wind-velocity distribution measurements in the dummy model and the smoothing section. Outer electrodes are now being used as receiving electrodes to reduce the leakage capacitance. Other developments include the mounting of coaxial rings on the dummy model of the Gerdien chamber, construction and testing of a new ion gate generator, and the ionization source support and Gerdien chamber redesign. R.N.A.

N65-25822# RAND Corp., Santa Monica, Calif.

THE WORLD MAGNETIC SURVEY AND THE EARTH'S INTERIOR

E. H. Vestine Apr. 1965 16 p refs Presented at the Intern. Symp. on the Earth's Interior, Pittsburgh Univ., 16–20 Nov. 1964

(P-3104; AD-614409)

The present World Magnetic Survey is described, and discussed in relation to defining the earth's main field and secular change. Some effects dependent on geomagnetic noise levels affecting the survey are indicated. Difficulties incident to the extrapolation of faulty surface-field data to the surface of the core are noted. The extrapolated results of previous surveys are used to indicate the possible principal descriptive features of surface fluid motions that are derived for the outer core. Author

N65-25849# Joint Publications Research Service, Washington, D. C.

STUDIES IN AEROLOGY OF POLAR REGIONS

S. S. Gaygerov 18 Jun. 1965 76 p Transl. into ENGLISH from the book "Aerologiya Polyarnykh Rayonov" Moscow, 1964 p 3–66, 90–92, 117–118, 155–156, 230–232

(JPRS-30687; TT-65-31292) CFSTI: $3.00

The results of several aerological investigations of polar regions, which preceded the International Year of the Quiet Sun (1964–65), are presented. Characteristic features of the atmosphere, troposphere, tropopause, and stratosphere, such as structure, wind, and temperature data, are compared for the Arctic and Antarctic regions. L.S.

N65-25952# Northrop Corp., Palos Verdes Estates, Calif. Nortronics Div.

HIGH ALTITUDE DAYTIME SKY BACKGROUND RADIATION MEASUREMENT PROGRAM. PART I: SKY LUMINANCE, POLARIZATION, AND ALBEDO DATA FROM RESEARCH VEHICLE NO. 1

W. M. Clark Wright-Patterson AFB, Ohio, AF Avionics Lab. May 1964 233 p

(Contract AF 33(657)-11081)

(NORT-64-74; AL-TDR-64-134, Pt. I; AD-604031)

The radiation characteristics of the daytime sky background are a primary factor in establishing the performance characteristics of star tracking components for stellar-inertial guidance systems. Nortronics has developed a high resolution Spectrophotometer which has been operated during high altitude flights of Research Vehicle #1 to measure the radiance, polarization, luminance, spectral distribution, and luminance ratios (albedo) of the daytime sky. The spectral range of investigation is from the near ultraviolet to the near infrared. Data were recorded from 20,000 to 70,000 feet altitude during six flights covering all daytime conditions from sunrise to sunset. The terrain over which data were taken included the California desert, the ocean, and a mountain range. Author

N65-25965# General Electric Co., Santa Barbara, Calif.

APPROXIMATE SERIES SOLUTIONS OF THE THREE-SPECIES ATMOSPHERIC DEIONIZATION DIFFERENTIAL EQUATIONS

R. L. Bogusch 1 Feb. 1965 34 p refs

(Contract DA-49-146-XZ-281)

(RM-65TMP-7; DASA-1597; AD-613199)

In the course of investigating the effects of a nuclear explosion on electromagnetic wave propagation, it is often convenient to consider the ionized constituents of the atmosphere to be represented by a single species of positive ions, a single negative ion species, and electrons. The number densities of these charged particles at a specific time after detonation

are then obtained from the solution of a system of three differential equations which describe the time rate of change of each particle density. An exact analytic solution has not been found for these equations, and hence either approximate analytic forms or numerical integration methods are employed. The latter offers high accuracy but is often too time-consuming for general application. In this report a new set of approximate analytic solutions are derived which provide accuracies approaching that of numerical integration for many cases, but which retain the advantage of rapid computation. Author

N65-25968# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research Labs.

TABLES OF NEUTRAL ATMOSPHERIC PROPERTIES AS A FUNCTION OF SOLAR ACTIVITY AND LOCAL TIME FROM 90 TO 10,000 KM

A. D. Anderson and W. E. Francis Mar. 1965 73 p
(LMSC-6-75-65-19)

A semi-theoretical model of the upper atmosphere has been constructed to allow the calculation of the primary neutral atmospheric properties (temperature, density, pressure, and composition) from 90 to 10 000 km as a function of local time and solar activity. The results of these calculations are presented in this report in the form of tables for various local times and solar activities ranging over a solar cycle. The density in the exosphere is corrected for the escape of atomic hydrogen from the Earth's atmosphere. In order to check the model, the temperature, molecular weight, density and number densities for O, O_2, and N_2 are computed from 130 to 200 km for conditions of solar activity and local time corresponding to measurements made by Nier et al. (1964) at White Sands on June 6, 1963. The observed properties and those calculated with the model differ by an average of 10 per cent. Author

N65-26012# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE PROPAGATION OF A SHOCK WAVE IN THE GROUND DURING IMPACT OF A VERY FAST METEORITE AGAINST THE SURFACE OF THE PLANET

Yu. P. Rayzer 26 Mar. 1965 10 p refs Transl. into ENGLISH from Tr. Desyatoy Meteoritnoy Konf. v. Leningrade 29 Maya–1 Iyunya 1962, Kom. po Meteoritam, Akad. Nauk SSSR, no. 24, 1964 p 82–86
(FTD-64-1038/1 + 2; AD-614018)

An idealized model of a hydrodynamic process, originating during impact of a meteorite on the surface of a planet without atmosphere, was used to explain the results of an approximate solution for the problem of shock wave propagation in a gas at centered impact along its surface. It was found that the law of shock wave damping is very close to the law of damping at an explosion in an unlimited medium, and thus appears to verify the above named approximation. G.G.

N65-26016# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE HENBURY METEORITE CRATERS

Paul W. Hodge Washington, D. C., Smithsonian Inst. [1965] 18 p refs *Its* Contrib. to Astrophys., Vol. 8, No. 8

Renewed interest in the Henbury Meteorite Craters has instigated several recent scientific studies of these unique objects. This paper summarizes the published and unpublished research that has been carried out so far and presents a table of dimensions newly derived, primarily from aerial photographs. A probable new crater is described, and a new map of crater outlines and locations is given. Sixteen photographs record the present condition of the crater system and form a photographic atlas of the craters and their surroundings. Author

N65-26091# Texas Univ., Austin. Defense Research Lab.

REPORT ON RESEARCH TO INVESTIGATE ATMOSPHERIC INFRASONIC PRESSURE VARIATIONS Annual Report No. 2, 1 Jun. 1963–31 May 1964

W. C. Richie 4 Jan. 1965 169 p refs
(Contract DA-36-039-SC-90719)
(DRL-A-237; AD-613264)

Continued research conducted under a program designed to determine transient infrasonic signal propagation past a station where infrasonic atmospheric measurements are being made, is reported. Presented is an analysis of instrumentation and signal processing techniques which were used in determining the statistical characteristics of atmospheric infrasonic pressure variations. Data are included on a solion full-wave linear pressure device which detects low-frequency, low-pressure, acoustic signals; and results of experimental investigations on the applicability of spectral and probability density analyses to atmospheric infrasound studies. S.C.W.

N65-26101# McGill Univ., Montreal (Quebec). Dept. of Meteorology

THE HEAT BUDGET OVER THE ARCTIC OCEAN Final Report

Eberhard Vowinckel and Svenn Orvig Feb. 1965 42 p refs *Its* Publ. in Meteorology No. 74
(Contract AF 19(604)-7415)
(AFCRL-65-230; AD-614646)

Heat fluxes at 300 mb and at the earth's surface were chosen to carry out heat budget calculations for several areas of the Polar Ocean. It was found that the radiative terms are far greater than all other influences, and the long-wave components are the greatest in all areas and months. Tropospheric energies over the Arctic show a sharp increase of nonradiative terms. Calculations for the earth-atmosphere energy budget show that the result of no advection into the North Polar regions would be a temperature drop of 35°C over the Norwegian-Barents Sea, and about 50° over the central Polar Ocean, setting the average total incoming energy at the top of the atmosphere equal to 100 units. G.G.

N65-26114# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FORMULATION OF TRAJECTORIES OF AIR PARTICLES WITH THE AID OF ELECTRONIC COMPUTERS

A. I. Burtsev and I. P. Vetlov 26 Mar. 1965 18 p ref Transl. into ENGLISH from Tr. Tsentral'noy Inst. Prognozov (Moscow), no. 128, 1963 p 46–55
(FTD-TT-64-1039/1+2; AD-614021)

Described is a computation system that utilizes displacement calculations of wind changes in time and space to formulate diagnostic trajectories of air particles. Geopotential data within three consecutive observation periods were used to calculate the diagnostic trajectories of air particles within diurnal periods over the territory of Europe and adjoining regions. The calculated trajectories were in good agreement with the initial field of absolute geopotential of 700 mb surface and its subsequent change. G.G.

N65-26137# Colorado State Univ., Fort Collins.
THE VELOCITY FIELD DOWNSTREAM FROM A TWO-DIMENSIONAL MODEL HILL. PART I Final Report
Erich J. Plate and Chi W. Lin [1964] 81 p refs
(Grant DA-36-039-AMC-63-67)
(CER-65-EJP-14, Pt. I; AD-614067)

A wind tunnel study is presented to determine the downstream disturbance effects of two-dimensional hill models on boundary layer flows. The wind tunnel and instrumentation used to measure pressures, mean velocities, turbulent velocity components and their spectra, turbulent shear stresses, and the location of the separation stream reattachment point are described. Modeling criteria and assumptions were in agreement with the experimental results for the velocity distributions at large distances downstream from the hill but no conclusions could be made for the flow in the standing eddy region directly downstream. R.N.A.

N65-26293# Defence Research Board, Ottawa (Ontario).
GEOGRAPHIC DISTRIBUTION OF IONOSPHERIC DISTURBANCE IN THE F2 LAYER
Ye. V. Lavrova Apr. 1963 10 p refs Transl. into ENGLISH from Tr. IZMIRAN (USSR), No. 19(29), 1961 p 31–43
(T-384-R; AD-610940)

Materials collected at 41 ionospheric stations during the International Geophysical Year were used to prepare charts dealing with disturbances over large geographical areas. A general examination of the Δf_0F2 charts indicates that disturbances in the F2 layer develop in high altitudes long before magnetic disturbances begin. Charts of the successive positions of the disturbance centers were then constructed to follow spatial variations. Movements of negative centers, which show the shifting of anomalous electron concentrations, are given for four different time periods. Distribution in longitude of Δf_0F2 ($\phi = 55°$ N) for four storms during September 1957 is also given. Such methods can be used to present an idea of the state of the ionosphere, provided data are available from ionospheric stations located over a wide area. From the synoptic charts, interpolation between the isolines can be used to determine conditions at points where there are no stations. By tracing movements of the disturbance centers, the state of the ionosphere can be forecast in any direction for three to six hours. It was concluded that ionospheric disturbance begins in northern latitudes, and that the data presented may be used for magnetic-ionospheric storm forecasting. M.W.R.

N65-26332# Wichita Univ., Kansas.
STUDY OF MICROPULSATIONS OF ABOUT 1 CYCLE PER SECOND Final Report, 1 Jan. 1963–31 Dec. 1964
A. W. Jenkins, Jr. and B. W. Du Vall 1 Jan. 1965 27 p refs
(Contract AF 19(628)-2477)
(AFCRL-65-98; AD-463320)

An analysis is made of several possible sources for geomagnetic micropulsations of about one cycle per second. These include hydromagnetic waves propagated downward from the magnetospheric boundary, natural resonance of the ionospheric current system, sudden changes in ionospheric parameters, and the effect of meteors. The attenuation of hydromagnetic waves is calculated for an ionospheric model that includes heavy negative ions. The results are inconclusive because of the technical difficulties involved in obtaining the mathematical solution. Resonance phenomena are found to produce effects at frequencies far removed from the one-cycle region. Meteor effects are a possible source of micropulsations at one cycle, and a detailed analysis is made for this case. This work is being continued with Air Force support. Author

N65-26436# Army Map Service, Washington, D. C.
THE ASTRO-GEODETIC ADJUSTMENT, INCLUDING THE ADJUSTMENT OF THE DEFLECTIONS OF THE VERTICAL, FOR A PRIMARY TRIANGULATION NETWORK
Isaac C. Lail Sep. 1964 56 p refs
(TR-49; AD-464718)

In geodetic nets, where several or more Laplace points are observed at intervals within the geodetic net, it may be desirous to utilize all the observations at these Laplace points in order that the geodetic net be astro-geodetically orientated and adjusted with the best orientation at the datum point in reference to the spheroid-geoid relationship as established at the Laplace points over the area in question. This computation is called the adjustment of the deflections of the vertical within the geodetic net in addition to satisfying the intrinsic geometric conditions within the net. Because there is in the geodetic literature no comprehensive description of the mathematics and procedure to be used in getting a "best" fit of a spheroid to a triangulation scheme with Laplace stations, this report is written. It gives a detailed description of the mathematics and procedure used, expands the mathematical treatment where necessary, and provides a specific example in the form of a hypothetical first-order net which is used in this report. Author

N65-26471# Joint Publications Research Service, Washington, D. C.
PRINCIPAL FEATURES OF THE GEOGRAPHIC DISTRIBUTION OF CLEAR SKY OCCURRENCE OVER SOME REGIONS OF THE NORTHERN HEMISPHERE DURING THE I.G.Y. PERIOD
V. Ya. Lobanova and Ye. F. Sycheva 23 Jun. 1965 9 p refs
Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Aeroklimatologii (Leningrad), no. 28, 1964 p 123–128
(JPRS-30752; TT-65-31313) CFSTI: $1.00

This article briefly discuss the principal features of the distribution of clear sky occurrence in January and July over Eurasia, North America, and the adjacent ocean regions, and adduce maps of the clear sky occurrence, made according to the observations of over eight hundred stations, averaged for the IGY (International Geophysical Year) and IGC (International Geophysical Cooperation) period. The category of clear sky in the present work includes the instances when, at the time of observations, clouds were either absolutely absent or were observed in the quantity not exceeding one point. The gradation selected (0 to one points) for the characteristic of clear sky differs by one point from the gradation adopted in climatology (0 to two points) which is termed the clear sky. The clear sky occurrence maps are made for the central months of the winter and summer seasons, on the average, for two years: for January, according to 1958 to 1959 observations, and for July according to 1957 and 1958 observations. The occurrence is expressed in percent of the total number of daily four-period observations for the month of a two year period, which includes 248 instances. N.E.A.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-25580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
PRECISION RANGE-GATED IMAGING TECHNIQUES Technical Report, Mar.–Sep. 1964
Don B. Neumann Jan. 1965 22 p
(AFAL-TR-64-278; AD-612790)

By properly delaying the 50-nanosecond shutter of an image-converter camera with respect to a transmitted 60-nanosecond illuminating pulse from a Q-switched ruby laser, the image formed may be limited to only those objects located in a certain range interval. Using this technique, the visibility through atmospheric scattering mediums, such as snow, may be greatly increased. In addition, the use of the technique enables range information to be added to an image, such as the elevation contours in an aerial photograph. Author

N65-25632# Naval Ordnance Lab., White Oak, Md.
MECHANICAL ZERO G DEVICE
L. D. Silvers May 1965 25 p ref
(NOLTR-64-127; AD-613937)

A working model of a mechanical device for sensing zero g or weightlessness has been developed. It is approximately 1 3/4 × 2 × 4 1/2 inches high and weighs 1.2 pounds. It requires electrical energy to energize a rotary solenoid which releases a self-starting timer. It arms in all planes at a g level below 0.15 and remains safe in all planes at a g level above 0.30. The present design will run for 39 seconds and sense the g level during the last 25 seconds. Six switches are positioned around a circular circuit disc for telemetering purposes. This model, which was designed and fabricated for flight on a missile in order to prove its feasibility, could be easily adapted to a particular missile by changing the timer and switching.
Author

N65-25633# Texas Instruments, Inc., Dallas. Apparatus Div.
MICROELECTRONIC FREQUENCY AND TIME STANDARD Quarterly Progress Report No. 3, 1 Jan.–1 Apr. 1965
15 Apr. 1965 23 p
(Contract NObsr-91352)
(U3-807240-3; AD-613999)

The design phase was completed and fabrication begun on some SCN's, despite delays in schedule. A prototype frequency standard has been built. A critical problem still exists with the CR-71/U crystals. Author

N65-25695# Atomics International, Canoga Park, Calif.
SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR Interim Report, 25 Mar. 1964–15 Feb. 1965
D. E. Spiel and R. W. Boom [1965] 65 p refs
(Contract DA-18-035-AMC-107(A))
(AI-65-36; AD-612677)

Techniques employed in the application of superconducting thin films to nuclear particle detection are presented. The development of a theory based on a thermal spike model to explain alpha particle induced pulses in thin films is described. In experiments where films were exposed to alpha bombardment, the critical currents were lowered by an amount predicted by the model. Normal regions were observed to initiate at random points along the film as opposed to the nonbombardment fixed position origin, and were observed to occur at a rate consistent with the source strength and source film geometry used. Below the critical current levels, nonpropagating pulses appear when alphas are applied, disappear when they are removed, and have amplitudes predicted by the model. Results of the experiments and their comparison with theory predictions are given. Techniques used in manufacturing and testing the detectors are included. R.N.A.

N65-25752# Consolidated Electrodynamics Corp., Pasadena, Calif.
STUDY AND DEVELOPMENT OF THE PAUL-TYPE MASS SPECTROMETER Final Report
Wilson M. Brubaker Apr. 1963 196 p refs
(Contract AF 19(604)-5911)
(AD-461021)

This project is directed toward application of the quadrupole mass filter to analysis of the composition of the earth's upper atmosphere. Contributions were made to the theory of the operation of the mass filter, and experiments leading to improved understanding of the device performed. The latter explored the transmission of the filter as functions of the position and angle at which the ions enter the filter, the energy of excitation of the filter, and the details of the entrance geometry. It was found that the addition of an auxiliary set of electrodes placed near the entrance aperture greatly improves the transmission efficiency for ions which enter the filter under unfavorable conditions. Following the theoretical and experimental studies, two flyable mass filters were designed, built, and tested. These have no ion source, and are responsive to the ambient ions picked up by the motion of the satellite vehicle. Unit resolution to mass 44 is readily obtained with these systems. They are responsive either to positive or to negative ions. The design objectives are easily met with this apparatus. An ion current amplifier and a scanning power supply were designed for ground tests of the quadrupole filter. Operational equipment for satellite use included two rf oscillators using NUVISTOR tubes, an rf oscillator using transistors, a variable capacitor ion current amplifier, and a logarithmic amplifier. An analysis was made of the noise and response characteristics of the electrometer tube current amplifier. Complete descriptions of all the electronic circuits are included. Author

N65-25821# Rochester Univ., N. Y. Inst. of Optics
A SERIES OF LENSES DESIGNED ON LARGE COMPUTERS
R. E. Hopkins [1964] 8 p ref Presented at Intern. Comm. for Optics Conf. on Phot. and Spectroscopic Optics, Tokyo and Kyoto, 1–8 Sep. 1964
(Grant AF-AFOSR-50-63)
(AD-612500)

Four lenses were designed using a powerful automatic computer correcting program to provide information on their performance. The design specifications for the lenses are a focal length of 24 inches, an f-number of 6.0, a full field format of 9 square inches, and a color correction of 4800 to 6500 Å. The geometrical energy distributions for the design solutions of three point images in the field, the geometrical modulation transfer curves, and the estimated resolving power on Plus X Aerecon film are given in graphs. Design data are tabulated. The design study shows the advantage of using four elements instead of three, and that the gain in using unusually high index glasses is marginal. R.N.A.

N65-25912# Stanford Research Inst., Menlo Park, Calif.
PRESSURE TRANSDUCER FOR MEASURING SHOCK WAVE PROFILES. PHASE X: MEASUREMENT OF LOW-PRESSURE SHOCK WAVE PROFILES Progress Report, 1 Feb.–28 Feb. 1965
D. D. Keough and R. F. Williams 8 Mar. 1965 5 p refs
(Contracts DA-49-146-XZ-096; DA-49-146-XZ-280)
(PR-11; PR-42; AD-612491)

New developments are reported on a pressure transducer for measuring low pressure shock wave profiles. An attempt to replace epoxy with aluminum in the granite column of the cylindrical granite gauge resulted in short duration recordings and distorted waveforms. Lead tip connections were vacuum deposited with gold and separated from the calcium element to

provide isolation between the calcium and reactive filler materials used in placing the leads in the Hi-D glass substrate of calcium transducers. Equation of state data on a fired Hi-D glass wedge agreed with data on a previous wedge. R.N.A.

N65-25926# Joint Publications Research Service, Washington, D. C.
AN INVESTIGATION OF THE POSSIBILITY OF USING ELECTRETS IN METEOROLOGICAL INSTRUMENTS
N. S. Varzhenevskiy and R. A. Mel'tser 8 Jun. 1965 9 p refs Transl. into ENGLISH from Tr. Nauchin. Issled. Inst. Gidrometeor. Priborostr. (Leningrad), no. 12, 1964 p 84–88
(JPRS-30467; TT-65-31184) CFSTI: $1.00

Research relating to the development of ceramic electrets is discussed. Results indicated that while an electret made of calcium titanate can retain an electric charge for about three years, it, like other ceramic electrets, is not usable as a humidity sensor because of its great inertia. Efforts at decreasing inertia, by using charcoal during the baking of the ceramic, have not brought the desired results. While electret films have less inertia, they also have less charge for surface area than the ceramics. From a meteorological standpoint, there is interest in the electret generator because it requires no current and can transfer the energy it produces for great distances. The feasibility of using the electret generator with a remote control anemometer is suggested. M.W.R.

N65-25934# United Kingdom Atomic Energy Authority, Windscale (England). Production Group
METHOD FOR THE CALIBRATION AND CONTROL OF A GAMMA RAY SPECTROMETER
1964 27 p refs
(PG-627-W) HMSO: 4s

Method of setting up and calibrating a spectrometer to carry out quantitative analysis of gamma ray spectra is described. Methods of controlling the performance of the intrument and testing operation are also described. An indication is given of the way the data obtained from a set of standard spectra can be reduced into forms convenient for application to quantitative analysis. Author

N65-25963# Honeywell, Inc., Minneapolis, Minn.
A MANUAL DEVICE FOR LOCATING ELECTRIC ARC-PRODUCING FAULTS Final Technical Report
Richard T. Stevens Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1965 141 p refs *Its* Rept.-20070-FR1
(Contract AF 33(615)-2031)
(AFAPL-TR-65-25; AD-613263)

It is known that certain types of electronic circuit and component defects can generate RF fields when energized. This program's purpose is to develop a noncontacting portable instrument for locating defective components and circuits which generate these RF fields. To implement this program, initial effort was concerned with a study of the RF spectrum generated by various defective components and circuits. The spectrum was found to be rich in RF noise in the vicinity of 26 megacycles. Accordingly, a portable broad band 26-megacycle radio receiver and associated RF pickups were developed. The receiver was designed for the highest gain and the lowest noise figure attainable in a portable device. Several RF pickups were designed to provide a moderately directional means of coupling to both RF voltage fields and RF current fields. The effectiveness of this equipment was evaluated using specially constructed sources of localized RF fields. The equipment was also used for locating simulated defective circuits and components as well as actually defective circuits and components. These experiments show that circuit and component defects resulting in an electric spark discharge can usually be detected by the receiving equipment developed under this program. The results also show that extremely low level RF disturbances, such as those generated by noisy diodes, usually cannot be detected by the receiving equipment developed under this program. When used with this limitation in mind the equipment should provide a highly effective portable device for locating a large number of electronic circuit and component defects. Author

N65-26007# Lincoln Lab., Mass. Inst. of Tech., Lexington.
CALIBRATION OF A PRESSURE SENSOR FOR MEASUREMENTS IN CONTINUUM AND RAREFIED GAS FLOWS
W. M. Kornegay and J. D. Fridman 8 Feb. 1965 27 p refs *Its* Tech. Rept. 379
(Contract AF 19(628)-500; ARPA Order 600)
(ESD-TDR-65-43; AD-614424)

The free-stream flow behind shock waves produced in the laboratory has been used to obtain a dynamic calibration of a highly sensitive piezoelectric pressure sensor under a wide variety of conditions. Experimental results on the influence of rarefied gas flow on the value of stagnation pressure measured with the sensor are described. This report covers the continuum, slip and transition flow regimes. Design characteristics of the pressure sensor are presented and experimental results are discussed in view of the impact pressure measurements of other authors. Author

N65-26011# Rhode Island Univ., Kingston. Div. of Engineering Research and Development
THIN CYLINDRICAL CERAMIC TRANSDUCERS
N. T. Chieu and F. H. Middleton 1 Oct. 1964 82 p refs
(Contract Nonr-396(12))
(TR-6; AD-612714)

Free-flooded thin cylindrical ceramic rings have distinct advantages in deep water transducer applications. Their actual behavior in different resonance modes is not well known. To study this problem an extensive review of the existing theories on the finite cylinder has been made, the advantages and disadvantages of each pointed out. Moreover, four model rings are used in the laboratory to study the problem experimentally. Ring pairs of 1.25" and 1" in diameter are identical except for heights which range from 1.5" to 0.5". The frequency range is from 10 kc to 200 kc. The pulse technique is used and the results include response characteristics, impedance curves, radiation patterns and power output characteristics for both the free-flooded and air-backed arrangements. The same ring is used for flooded and pressure-relieved experiments so that there are no extraneous differences in the two cases. This is accomplished by means of a very thin membrane cemented to each end of the ring. The compliance of the membrane is so large that mechanical effects on the ring itself are negligible. Author

N65-26077*# Rosemount Engineering Co., Minneapolis, Minn.
DEVELOPMENT OF SENSOR TO MEASURE HOT GAS LEAKS FROM FLANGES AND SEALS IN PLUMBING OF SATURN VEHICLE Summary Report, 30 Jun. 1963–30 Jun. 1964
8 Jul. 1964 53 p refs
(Contract NAS8-5451)
(NASA-CR-63281; REC-7648) CFSTI: HC $3.00/MF $0.50
CSCL 14B

A mass flow sensor was adapted for use in measuring hot gas leaks from flanges and plumbing seals in the Saturn launch vehicle. The primary problem was to devise thermal protection for the sensing element and the electronics from the high temperatures of the gases and the space environment. Isolation from the temperature of the gases is obtained by an annular counterflow heat exchanger system. Protection against

the environmental temperature is provided by insulation and by low-conductive attachment of the sensing element and electronics to the base of the unit. The low temperature requirement is met by use of controlled heaters on the gas heat exchanger and on the electronics package. A detailed account of the sensor design, the electronics, packaging, and verification tests, is given. J.M.D.

N65-26082*# California Univ., San Diego. Marine Physical Lab.
[EXPERIMENTAL RESEARCH ON TECHNIQUES FOR DETERMINATION OF MAGNETIC PROPERTIES OF LUNAR AND PLANETARY MATERIALS] Final Report
Victor Vacquier 1 Mar. 1965 50 p refs
(Grant NsG-303)
(NASA-CR-63381; MPL-U-2/65) CFSTI: HC $2.00/MF $0.50 CSCL 03A

In the course of investigating the applicability of proton magnetometers to the measurement of magnetic fields on the surface of the moon from an unmanned vehicle and to explore the feasibility of measuring the magnetic properties of the moon surface, a study was made of the factors entering into the design of a sensing head for proton magnetometers. This study does not give the optimum design but discusses the various factors which influence the detection of the proton signal and discussed methods by which these factors may be evaluated. A description is given of a constructed portable proton magnetometer. The portable proton magnetometer described measures the total geomagnetic field intensity to an accurate gamma with a minimum between measurements of six seconds. N.E.A.

N65-26130# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
A SLITLESS SPECTROGRAPH FOR HYPERVELOCITY FREE-FLIGHT RANGE APPLICATIONS
I. D. Liu Jan. 1964 37 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj Defender)
(TR65-01B; AD-463042)

This report describes the design and construction of a large-aperture spectrograph for observing low-intensity, short-duration events in ballistic test ranges. The instrument is of the Bass-Kessler type modified by a slitless arrangement to improve its light-gathering power and the reproducibility of results. The spectrograph has been operationally tested in an experimental program where spheres and cones of various bluntness were launched in air at velocities in excess of 20 kft/sec. Some of these models were intentionally seeded to enhance spectral radiance. The spectrograms obtained, which are presented and discussed in the report, show good sensitivity, resolution, and consistency. Author

N65-26233# Itek Corp., Lexington, Mass.
INFRARED CONTROLLED DEVELOPMENT TECHNIQUES
J. Hughes Wright-Patterson AFB, Ohio, AF Avionics Lab., May 1965 75 p refs
(Contract AF 33(615)-1771)
(AFAL-TR-65-47; AD-464488)

Developing techniques are discussed in which the rate of development of localized areas of a photographic emulsion can be controlled by heating. A procedure is proposed which would use the infrared radiation from a xenon arc lamp. The radiation would be imaged to a 1-millimeter spot and scanned across the processed film. Preliminary experimentation indicated that a 10X speed range can be induced by the temperature control. Preparations were being made to investigate this concept on a breadboard processor, but the program was terminated before this work could be completed. This technical documentary report has been reviewed and is approved. Author

N65-26239# General Electric Co., Syracuse, N. Y. Tube Dept.
VIDICON TRACKER DEVELOPMENT Final Engineering Report
Kurt Schlesinger, P. V. Oakes et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1965 55 p refs
(Contract AF 33(657)-11652)
(AFAL-TR-65-19; AD-464561)

A vidicon tube with magnetic focus and electrostatic deflection is described. The tube uses a new type of crossed-field system, which employs a Deflectron cylinder immersed in a magnetic field. A Pierce gun with 0.5-mil aperture is used. A sample tube in a 5" X 1" envelope yields a signal current of 0.48 microampere at 900 volts. It scans a 5/8" target with 70 volts of sweep and shows 2400 lines per inch, or 900 TV lines, with good center-to-edge resolution. A miniature version of the above vidicon operates within an envelope of 3-3/4" X 5/8". The Deflectron is printed directly on the inside of the glass cylinder. The picture has excellent geometry out to 90 per cent of the target diagonal. Resolution is reduced by the scale factor (600 TV lines), but spot-size and sweep voltage demand are the same. Author

N65-26247# Bendix Corp., Teterboro, N. J. Eclipse-Pioneer Div.
INTERFEROMETRIC SHAFT ENCODER Final Report, Nov. 1963–Nov. 1964
Walter W. Lee Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1965 76 p refs
(Contract AF 33(615)-1103)
(TDR-AFAL-TR-65-81; AD-463298)

This paper discusses a new approach to the problem of shaft angle measurement. This approach uses interferometric techniques to measure the angle and to give an output in binary code. A computer simulation, detailed analysis, and the construction and evaluation of a breadboard unit are given, and the problems involved in making a practical unit are discussed. Author

N65-26282# Aerospace Corp., El Segundo, Calif. Manned Systems Div.
THE INITIATION OF DOD PHOTO/OPTICAL EXPERIMENTS ABOARD THE GEMINI SPACECRAFT
Ernest U. Gambaro 6 Mar. 1964 23 p refs
(Contract AF 04(695)-269)
(TOR-269(4532-20)-2; AD-460972)

A common set of photographic system and human performance parameters was postulated for use in three planned photo-optical experiments from aboard the Gemini manned orbital spacecraft. The suggested system consists of a number of lenses, films, and camera bodies. The compact lenses will provide several fields of view and several degrees of image magnification. The camera bodies will be compact and rugged, be of usable format, and have the capability of reflex viewing. The astronaut is to select the proper equipment for a given mode of operation, discriminate and acquire the selected target from its background, track the target, and operate the equipment. In addition, he will record his visual and physical impressions. Focal length, apertures, and other pertinent data for the lenses are given. These experiments from a manned orbital vehicle, in which the photographic system is intentionally integrated into the total man–machine control loop, are planned to obtain data on man's ability to control such systems. L.S.

N65-26314# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group

EVALUATION OF A HEAD WORN AUDIO-VISUAL AID Final Report

Herman T. Brown, Jr. Nov. 1964 30 p ref

(Contract Nonr-4098(00))

(FR-64-10-333; AD-461613)

A head-worn audio-visual device for guiding persons through a series of tasks was tested against a less compact device which is known to be beneficial as a performance aid. This head set, which weighs only 30 ounces, consists of a one-inch diameter high resolution cathode ray tube, mechanical adjustments which allow positioning relative to the eye, an optical system which produces a virtual image of the cathode ray tube face, a control which adjusts the focal plane of the magnified virtual image at distances from two feet to optical infinity, and a headpiece which holds all of these components. The optical system includes a semitransparent mirror which allows the user to study the reflected image or to look through the mirror at his environment. Twelve individuals tried both the head-worn viewer and the standard device in performing certain alinement operations: six preferred the head set, four chose the standard device, and two expressed a preference for instruction manuals rather than audio-visual aid. J.M.D.

N65-26333# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A CORRIDOR MONITOR FOR THE DETECTION OF $\beta\gamma$ CONTAMINATED PERSONS UNDER CONDITIONS OF VARYING γ BACKGROUND

A. R. Jones Feb. 1965 14 p refs

(AECL-2235) Available from Atomic Energy of Canada, Chalk River: $0.50

A monitor for the detection of $\beta\gamma$ contamination on persons moving along a corridor is described. The monitor has a sensitivity to β or γ contamination which is proportional to the square root of the γ background. This provides the maximum sensitivity at all acceptable γ backgrounds which is compatible with a tolerable level of false trips caused by statistical fluctuations. A detailed circuit description and setting-up procedures are given in the appendix. Author

N65-26335# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation

REACTOR INSTRUMENTATION AND CONTROL Progress Report, 1 Mar.–30 Apr. 1965

28 May 1965 25 p refs

(Contract AT(40-1)-2847)

(GEMP-88) CFSTI: $2.00

Work on capacitance temperature sensors continued. A molybdenum-single-crystal alumina sensor was successfully tested up to 2000° C in an argon atmosphere with the use of a newly developed transistorized readout circuit. An ac guard-ring ionization chamber was designed, and single-lead ac chambers and ac power range control system components were tested. The application of magnetic fields to retard the flow of low-energy secondary electrons to achieve output-current stability for charged neutron sensors was unsuccessful. Unpowered thermal-neutron sensors utilizing capture gamma rays and internal-conversion electrons were constructed and tested. Very stable output currents were produced by the unpowered gamma sensors at more than 168 hours run at a gamma dose rate of 6.8×10^5 r/hr. Cadmium emitter sensors had an average gamma sensitivity of 7×10^{-17} amp/r-hr, and gadolinium emitter sensors a 1.6×10^{-17} amp/r-hr sensitivity. Cadmium and gadolinium sensors responded instantaneously to the insertion or removal of the regulating rod with no indication of deterioration of output current stability. G.G.

N65-26336# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation

CAPACITANCE TEMPERATURE SENSOR Final Report

D. E. Joyce 25 Jun. 1965 58 p

(Contract AT(40-1)-2847)

(GEMP-89)

This report describes an investigation of the use of the change of dielectric constant of ceramic capacitance elements as a means of measuring temperature, and the incorporation of such ceramic elements into two complete temperature measuring systems which were developed for service in both oxidizing and non-oxidizing atmospheres. Author

N65-26400*# Eon Corp., Brooklyn, N. Y.

STERILIZABLE GEIGER-MUELLER TUBES FOR SPACE APPLICATIONS Final Report

G. R. Weinberg, Nicholas G. Anton, Sidney Sturtz, Michael Moss, and Myron Youdin 22 Mar. 1965 145 p Prepared for JPL

(Contracts NAS7-100; JPL-CPFF-950681)

(NASA-CR-63394) CFSTI: HC $4.00/MF $1.00 CSCL 18D

The details of design, fabrication and evaluation of two gas and heat sterilizable Geiger-Mueller tubes (Types 5112R and 6226) developed for space applications, are covered in this report. The Type 5112R has a stainless steel thin wall cathode (30 mg/cm^2) and the 6226 a grid supported thin end mica window (1.4-1.5 mg/cm^2). Samples of both tube types were subjected to all electrical, sterilization and environmental tests as required by the Jet Propulsion Laboratory specifications for this study. In addition, the tubes were subjected to extensive shelf life tests and active tests at high counting rates. All JPL requirements were met successfully by the EON detectors. Drawings and specifications for both tube types; sketches of test fixtures, including those required for shock and vibration and evaluation test data are included in the report and its appendices. Author

N65-26405*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NIMBUS I HIGH RESOLUTION RADIATION DATA CATALOG AND USERS' MANUAL, VOLUME I: PHOTOFACSIMILE FILM STRIPS

L. Foshee, G. W. Nicholas, ed., W. R. Bandeen, W. Fizell, P. S. Hoffrichter et al 15 Jan. 1965 234 p refs

(Contract NAS5-3253)

(NASA-TM-X-56565) CFSTI: HC $6.00/MF $1.25 CSCL 20F

The Nimbus I Meteorological Satellite contained a High Resolution Infrared Radiometer (HRIR) designed to map nighttime cloud cover and surface temperatures from emission within the 3.5–4.1 micron atmospheric window. HRIR data were acquired from a near-polar orbit during the period 28 August–22 September 1964, after which a spacecraft malfunction occurred. In this Volume the radiometer design, calibration, and performance, the photofacsimile processing, and the coverage and documentation of the data are discussed. The successfully reduced data are documented in three forms. One form consists of an "Index of Available High Resolution Infrared Radiometer Film Strips (Photofacsimile)," a second of "Subpoint Track Summaries of Available Radiation Data," and a third of "Contact Prints of Available Photofacsimile Film Strips." The data documented in this Volume are available in the form of 70mm positive or negative transparencies or positive contact prints. Author

N65-26473# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
SOME FOCUSING PROPERTIES OF AN IRON ORANGE β-RAY SPECTROMETER
J. S. Geiger Mar. 1965 22 p refs
(AECL-2237) Available from Atomic Energy of Canada, Chalk River: $1.00

In order to obtain information necessary for the design of a seven element detector array a study was made of the width of the image formed by electrons focused by different parts of one gap of the Chalk River orange β-ray spectrometer. The focused image profiles were recorded on no-screen X-ray film. Results are presented for focal cylinder radii of 15.6 mm and 41.9 mm. The variation of the focusing magnetic field strength with orbit position in the gap is given for focal cylinder radii of 15.1 mm and 40 mm. The relevance of the present findings to the focusing of 6 gap orange β-ray spectrometers is considered. Author

N65-26480 Oak Ridge National Lab., Tenn.
IMAGE FORMATION IN A HIGH-RESOLUTION ELECTRON MICROSCOPE
T. A. Welton *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 19–21 (See N65-26475 15-24) CFSTI: $6.00

A series of calculations were performed to explore the feasibility of molecular structure determination by use of a suitably designed electron microscope. It was concluded that: (1) A conventional electron microscope when properly defocused for optimum phase contrast can yield only about 5% contrast for a carbon atom. For a heavy atom such as gold or osmium, this increases to about 20%. (2) A high-resolution instrument will yield about 25% contrast for carbon, 200% for bromine, and correspondingly higher figures for heavier atoms. (3) Radiation damage restrictions place a stringent limitation on the atomic location information which can be extracted from a single molecule. For a typical biological molecule, a total dose of 100 electrons/A^2 will cause very serious rebonding and consequent structural distortion. (4) For selected problems in molecular biology, a high-resolution electron microscope is a valuable supplement to existing methods. E.E.B.

N65-26508# Library of Congress, Washington, D. C. Aerospace Technology Div.
QUALITY OF THE PHOTOGRAPHIC IMAGE [KACHESTVO FOTOGRAFICHESKOGO IZOBRAZHENIYA] Translations of Soviet-Bloc Scientific and Technical Literature
11 Mar. 1965 376 p refs Transl. into ENGLISH from Usp. Nauchnoy Fotografii (Moscow), v. 10, 1964 266 p
(ATD-T-65-10; AD-460800)

Translations of articles on scientific photography—the optical image, the photographic image, television image, grain structure of images, and photographic materials. For individual titles see N65-26509–N65-26547.

N65-26509 Library of Congress, Washington, D. C. Aerospace Technology Div.
QUALITY OF THE OPTICAL IMAGE. EVALUATION OF PHOTOGRAPHIC SYSTEMS BY THE METHOD OF FREQUENCY–CONTRAST CHARACTERISTICS OF A SINUSOIDAL GRID
A. T. Ashcheulov, T. A. Pavlichuk, and M. D. Khukhrina *In its* Quality of the Phot. Image 11 Mar. 1965 p 7–24 refs (See N65-26508 15-14)

The use of grid objects for evaluation of image-producing systems is described. The type of grid referred to is that in which the distribution of light follows a certain sinusoidal law, which in turn determines the distribution of brightness in the image. This known relationship suggests an evaluation criterion, in terms of dissimilarity between the distributions for the object and for the image. A contrast transmission coefficient is defined which is the ratio of the image contrast to the object contrast. It is shown that this coefficient can be used to assess the quality of image-generating systems of any given frequency, when sinusoidal grids serve as the objects. Also, in certain cases, this ratio makes it possible to compute the relationship of the size of the object to be resolved in the image and its contrast under realistic exposure conditions. J.M.D.

N65-26510 Library of Congress, Washington, D. C. Aerospace Technology Div.
MEASUREMENTS OF FREQUENCY–CONTRAST CHARACTERISTICS OF PHOTOGRAPHIC LENSES
A. T. Ashcheulov and N. P. Berezin *In its* Quality of the Phot. Image 11 Mar. 1965 p 25–39 refs (See N65-26508 15-14)

A photoelectric test stand was devised for direct measurement of the coefficient of contrast transmission of photographic lenses. In this measurement technique a mire grid with a sinusoidal distribution of the coefficient of transmission is inserted in the focal plane of a collimator, and a narrow slit is placed in the focal plane of the lens being tested. The measuring system registers the light beam passing through the slit. As the grid is shifted within its own plane, the degree of contrast is determined for the optical image. The value for the grid contrast is then used to obtain the coefficient of contrast transmission for the given grid mesh density. The choice of the measuring system is based on an analysis of known measurement methods. Tests of the photoelectric stand using various lenses confirmed the reliability of the method. J.M.D.

N65-26512 Library of Congress, Washington, D. C. Aerospace Technology Div.
EVALUATION OF THE QUALITY OF PHOTOGRAPHIC LENSES ON THE BASIS OF ANGULAR RESOLUTION LIMITS
V. A. Matveyev *In its* Quality of the Phot. Image 11 Mar. 1965 p 55–60 refs (See N65-26508 15-14)

Various typical aerial photography lenses were tested to determine whether the focal length and the angular limit of resolution are inversely proportional. Fifteen standard lenses with focal lengths ranging from 400 to 3000 mm were subjected to photographic tests to evaluate their resolving power for a given field. The photographs were taken on an optical bench, with a five-meter collimator and an orange filter. Median angular resolution, weighted for the area of a square frame in the assigned angular field, was chosen as the criterion for quality rating. For the lenses of moderate focal lengths, in the 500 to 750 mm range, the increase in quality rating appears to be approximately proportional to increase in focal length; above this range the improvement of the quality rating with respect to increasing focal length slows down. J.M.D.

N65-26513 Library of Congress, Washington, D. C. Aerospace Technology Div.
EXPERIMENTAL INVESTIGATION OF BORDER SHARPNESS PRODUCED BY MOTION PICTURE CAMERA LENSES
F. S. Novik and M. M. Shcheglov *In its* Quality of the Phot. Image 11 Mar. 1965 p 61–77 refs (See N65-26508 15-14)

For evaluation of the image quality associated with lenses used in motion picture photography, a method is presented for testing lenses on the basis of border sharpness in the image. Lenses with short, normal, and long focal lengths were chosen to photograph a shield consisting of two rows of translucent radial mire grids; the results of the tests are shown in the form of graphs of the boundary curve of the image. Analysis of these graphs shows that the boundary curve represents a fairly accurate method of evaluating the quality of transmission of a semiplane onto film. It was also found that there frequently is little agreement between the values determined from the boundary curves and the resolution value for the lenses being tested. J.M.D.

N65-26514 Library of Congress, Washington, D. C. Aerospace Technology Div.

EVALUATION OF THE QUALITY OF MOTION PICTURE CAMERA LENSES ON THE BASIS OF SHARPNESS

A. L. Yarinovskaya *In its* Quality of the Phot. Image 11 Mar. 1965 p 78–82 (See N65-26508 15-14)

A method of assessing the quality of optical images with the aid of boundary curves was tested on a large number of motion picture photographing and projection lenses. (The results showed a satisfactory concordance with evaluations made on the basis of the photographic image.) This criterion of image quality takes into account the distribution of light in the image along the border of adjacent light and dark fields. A microphoto attachment was used with the lenses used to photograph a test object placed in the focal plane of the collimator. Lenses with focal lengths of between 16 and 150 mm were tested; the test object was a round uniformly illuminated hole, divided along its diameter by a razor blade. Evaluation of the photographed images was on the basis of area calculated under the image boundary curves, which includes such factors as degree of incline of the curve, zone of unsharpness, and density drop. J.M.D.

N65-26515 Library of Congress, Washington, D. C. Aerospace Technology Div.

MEASUREMENT OF THE FREQUENCY—CONTRAST CHARACTERISTIC OF MOTION PICTURE CAMERA LENSES

F. S. Novik and A. P. Aksenchikov *In its* Quality of the Phot. Image 11 Mar. 1965 p 83–93 refs (See N65-26508 15-14)

An experimental photoelectric installation was constructed, for testing light distribution in an optical image created by motion picture camera lenses in the center of the field, at various relative apertures up to f:16. The frequency-contrast characteristics of a set of lenses were measured for evaluating their image quality, and graphs were plotted showing the relationship between relative contrast and spatial frequency. The relationship (in the center of the field) between the image contrast of a radial mire and the relative aperture of the lens was also investigated. L.S.

N65-26516 Library of Congress, Washington, D. C. Aerospace Technology Div.

QUALITY OF THE PHOTOGRAPHIC IMAGE. A STUDY OF MOTION PICTURE IMAGE QUALITY

I. B. Blyumberg and T. M. Zyazina *In its* Quality of the Phot. Image 11 Mar. 1965 p 94–104 refs (See N65-26508 15-14)

The criteria of sharpness, graininess, tone reproduction, and resolution of fine detail were studied for evaluating the quality of a photographic image. Tone reproduction was evaluated by setting up brightness–contrast characteristics. Results indicate that the greater the scale of brightness of the image photographed, the greater the distortion in tone reproduction. Equations for tone reproduction are given, and the conditions necessary for producing motion picture images with satisfactory tone reproduction are indicated. Other measuring techniques show that the resolution of fine detail and sharpness in each consecutive image is lower than in the preceding one. The way in which the losses in resolution and sharpness are related to various factors was studied, and values for these quantities in the projection positives are determined. It was also found that the value of the graininess factor in a subsequent image may increase or decrease in comparison with its value in the preceding one, depending on the change in sharpness, resolution, contrast, and brightness. The maximum permissible values for graininess in the projection positives were obtained. L.S.

N65-26517 Library of Congress, Washington, D. C. Aerospace Technology Div.

BOUNDARY CURVES AND SHARPNESS OF THE BLACK AND WHITE PHOTOGRAPHIC IMAGE

Yu. K. Vifanskiy and Yu. N. Gorokhouskiy *In its* Quality of the Phot. Image 11 Mar. 1965 p 105–117 refs (See N65-26508 15-14)

Properties of the boundary curves for black and white photographic images and their connection with subjective perception of sharpness were studied. The boundary curve defines the spatial distribution of the optical density at the border of the image. Primary interest was in the maximum spatial gradient, which is the maximum value of the derivative of the boundary curve. It was found that this maximum corresponds to an exposure value which is 1.5 to 5.0 times the optimum exposure for resolving capacity. In all cases tested an increase in the aperture of the objective lens increased the resolving power, while the maximum gradient increased only if finely dispersed photographic material was used. It was shown experimentally that subjective impression of sharpness can be numerically defined by the boundary curve in several equivalent ways; the preferred single-valued evaluation criterion is the difference between the densities at the beginning and end of the curve. J.M.D.

N65-26518 Library of Congress, Washington, D. C. Aerospace Technology Div.

BOUNDARY CURVES AND SHARPNESS OF THE COLOR PHOTOGRAPHIC IMAGE

Yu. N. Gorokhovskiy and G. I. Lozenvoy *In its* Quality of the Phot. Image 11 Mar. 1965 p 118–126 refs (See N65-26508 15-14)

A method of obtaining boundary curves for color photographic images is described. In using red-blue-green film, primary curves for the three colors are obtained from recordograms in zonal density and distance coordinates, and a triad of final analytic boundary curves of the elementary dye images are derived from linear equations which relate the dye surface concentrations to the zonal densities. The form of the boundary curves for the monochromatic dye images on both single and multilayer film depends on the exposure and development time in the same way as for black and white materials. In multilayer films the slopes of the boundary curves increase when the white light which exposes all three layers is replaced by filtered light which exposes one or another of the elementary layers. The values of the maximum spatial gradient which describe the slopes of the boundary curves were found to correspond in a satisfactory way to the subjective readability factor of the images of a text on multilayer film. J.M.D.

N65-26519 Library of Congress, Washington, D. C. Aerospace Technology Div.

AN OBJECTIVE CRITERION OF INFORMATIVE CAPACITY (AUTHOR'S ABSTRACT)

G. A. Istomin *In its* Quality of the Phot. Image 11 Mar. 1965 p 127–128 (See N65-26508 15-14)

To find a numerical criterion of image quality with good correspondence to visual perception of the image, a comparison was made of subjective and objective methods in tests of samples of negative motion picture materials. The objective method involves photographic diffusion measurement which was used to calculate the contrast function for black stripes of various widths located on a light background. From this function a diffusimetric constant was computed which showed a high negative correlation with visual perception. This confirmed the belief that visual perception of the zone of transition between a detail and the surrounding background, as well as the psychophysiological effect of image sharpness, must be inversely proportional to the square of the diffusimetric constant. The highest negative correlation, about −0.85, was obtained when graininess of the developed area was taken into account. J.M.D.

N65-26520 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE CONTRAST FUNCTION OF BLACK AND WHITE AND COLOR PHOTOGRAPHIC MATERIALS AND IMAGE SHARPNESS (AUTHOR'S ABSTRACT)

G. A. Istomin, I. G. Abidina, and Z. L. Petrushkina *In its* Quality of the Phot. Image 11 Mar. 1965 p 129–130 (See N65-26508 15-14)

A method based on photographic photometry of the image of a series of black stripes on a light background was devised in which a contrast function gives the empirical relationship between the contrast of the photographic image of the stripes and their widths. A sensitometer was used as the exposure instrument with a special test object to obtain the contrast function. A simple connection between the contrast function and the objective evaluation of the boundary sharpness of the photographic image was demonstrated under various exposure conditions for black and white and for color materials. J.M.D.

N65-26521 Library of Congress, Washington, D. C. Aerospace Technology Div.

A CRITERION FOR IMAGE SHARPNESS AND ITS EVALUATION IN VARIOUS CINEMATOGRAPHIC SYSTEMS

V. G. Komar *In its* Quality of the Phot. Image 11 Mar. 1965 p 131–144 refs (See N65-26508 15-14)

A method for quantitative evaluation of cinematographic systems with respect to angular screen dimensions and image sharpness is presented. An exponential function is given which expresses with sufficient accuracy the density-contrast curve both of the entire cinematographic process and its individual links, and of a human visual analyzer. A criterion of image sharpness is proposed; it is shown that the width of the zone of gradual change in brightness of the screen image outline is inversely proportional to the value of this criterion. A criterion of sharpness is offered which is inversely proportional to the angular magnifcation during projection. The angular dimension of the theater screen may be increased while preserving the necessary image sharpness, by enlarging the dimensions of the frame of the film positive, and by an increase in the critical spatial frequency of the cinematographic process. J.M.D.

N65-26522 Library of Congress, Washington, D. C. Aerospace Technology Div.

ON STANDARDIZATION OF RESOLVOMETRIC MEASUREMENTS

V. A. Korndorf and I. A. Chernyy *In its* Quality of the Phot. Image 11 Mar. 1965 p 145–149 refs (See N65-26508 15-14)

The relationship between the resolving power of photographic material and the aperture of the objective lens was studied to determine a standard aperture value for resolvometric measurements. The investigation was carried out with lenses in the aperture range 0.07 to 0.65. Three high quality microlenses–two of the apochromatic and one of the planachromatic type–were used in a resolvometer. Photographic materials ranging from low to high resolution power were tested, and in all cases the maximum resolution was obtained at an aperture of about 0.3. The planachromat lens which has a practically flat field and reduced chromatism is recommended as the most suitable type of lens. J.M.D.

N65-26523 Library of Congress, Washington, D. C. Aerospace Technology Div.

ENTROPY IN AN AERIAL PHOTOGRAPH

K. S. Lyalikov and Ye. G. Ivkina *In its* Quality of the Phot. Image 11 Mar. 1965 p 150–158 refs (See N65-26508 15-14)

A method is developed for determination of the entropy of aerial photographs. The statistical measure of entropy, taken from information theory, is $-\Sigma p_i \log_2 p_i$, where summation is over n values for the index. It is interpreted as the amount of information in a photograph. The p-values in the entropy measure are the observed relative frequency probabilities of n quantitative levels of optical density. The measure can be modified to good advantage by subtracting the entropy due to graininess in the photographic material. The film is read on a microphotometer and the area is broken up into small rectangles. Entropy was determined in a series of aerial negatives of several objects under various aerial photography conditions. In many cases the measured volume of information showed good coincidence with the qualitative evaluation of the aerial photographs. J.M.D.

N65-26524 Library of Congress, Washington, D. C. Aerospace Technology Div.

SENSITOMETRIC EVALUATION OF THE QUALITY OF BLACK AND WHITE AND COLOR AERIAL NEGATIVES

V. Ya. Mikhaylov *In its* Quality of the Phot. Image 11 Mar. 1965 p 159–165 refs (See N65-26508 15-14)

Sensitometric characteristics for objective evaluation of black and white and color aerial photographs are studied. In black and white negatives, an important property is the gradation characteristic which is determined by the value of the contrast coefficient. It was found that exposure time and the contrast coefficient are negatively correlated. Another important characteristic of the aerial negative is its average density, determined as the mean of the minimum and maximum densities observed in the negative. A good positive correlation is shown between the average and total densities for a large number of negatives. Data are presented which demonstrate that density values between 0.7 and 1.1 are within the optimum limits from the standpoint of fine and low-contrast details. Study of color negatives reveals good correspondence between the contrast coefficient in black and white and in color films. J.M.D.

N65-26526 Library of Congress, Washington, D. C. Aerospace Technology Div.
FORMATION OF REFLECTION HALOS IN PHOTOGRAPHIC LAYERS
K. V. Vendrovskiy and I. Z. Pakushko *In its* Quality of the Phot. Image 11 Mar. 1965 p 179–186 refs (See N65-26508 15-14)

The laws for the formation of reflection halos in photographic layers are studied. The relationships derived are based on the premise of complete scattering of the light by the photographic layers. An experimental verification showed that they are fulfilled with an accuracy which is sufficient for practical purposes. It is also shown that the intensity of reflection halos is considerably dependent on the shape and dimensions of the image which serves as the halation source. The authors are indebted to Professor G. A. Istomin for the valuable remarks which he made during discussion of the work. Author

N65-26527 Library of Congress, Washington, D. C. Aerospace Technology Div.
TELEVISION IMAGE AND ITS CONNECTION WITH A PHOTOGRAPHIC IMAGE EVALUATION OF THE QUALITY OF AN IMAGE REPRODUCED BY KINESCOPES
V. S. Gdalin *In its* Quality of the Phot. Image 11 Mar. 1965 p 187–195 refs (See N65-26508 15-14)

Quality of television pictures was studied with respect to contrast, and discussed in regard to definition, number of brightness gradations, and noise signals. For rating the contrast characteristic of contemporary kinescopes, the dependency of contrast on dimensions of reproducible image details was measured for scopes with and without a metal-plated screen covering, and with screens made from ordinary and neutral gray glass. Change of contrast was made with an image of a checkerboard field by means of an objective photometer using a photoelectric multiplier. Analysis of the data indicates that the magnitude of full and detail contrast is influenced both by thickness and transmission factor of the screen glass. A function of the ratio of total picture height to height of the checkerboard picture is presented which can be used for evaluation of the quality of a television picture. J.M.D.

N65-26528 Library of Congress, Washington, D. C. Aerospace Technology Div.
ON THE ANALOGY OF CHARACTERISTICS OF REPRODUCTION IN TELEVISION AND PHOTOGRAPHY
S. B. Gurevich *In its* Quality of the Phot. Image 11 Mar. 1965 p 196–210 refs (See N65-26508 15-14)

An analysis of the feasibility of developing a singular system for evaluating sensitivity and quality of image reproduction in television and photography, is presented. Proposed is a method for evaluating the accuracy of reproduction in both systems, which employs the use of the information theory for calculating the quantity of information transmitted; and a method for evaluating the sensitivity of these systems, which considers the magnitude reciprocal to the quantity of input radiation power per unit of information transmitted to the input of the television or photographic arrangement. Included are comparative data on the effects of the following factors on the proficiency of the two systems: noise and transmission of gradiations, distortions, resolving power, nonlinearity, conversion characteristics, and light-signal characteristics. S.C.W.

N65-26529 Library of Congress, Washington, D. C. Aerospace Technology Div.
TELEVISION METHODS OF INCREASING VISUAL DEFINITION OF PHOTOGRAPHIC IMAGES
V. A. Makhonin *In its* Quality of the Phot. Image 11 Mar. 1965 p 211–215 (See N65-26508 15-14)

Presented are experimental results of an investigation on the effectiveness of various methods of separating the informational elements of an image using a laboratory mock-up of an istropic nonlinear image converter. This device, which accomplishes mutual rotation of an image and the television raster, was assembled on the basis of a basic commercial television set. It is shown that the described device permits the selection of a broad class of conversions, including the separation of image details whose environment contains no other details of the same size, the separation of angular points of outline images, and the restoration of disintegrated images. Included are comparative data on television aperture compensators and electronic devices for improving photographic images, and a discussion of the feasibility of using television aperture compensators for increasing the resolving power of photo-optical systems. On the basis of experimental results, it was concluded that television image converters can be used for increasing the definition of photographic images simultaneously with aperture compensation for the eye. S.C.W.

N65-26530 Library of Congress, Washington, D. C. Aerospace Technology Div.
POTENTIAL MEANS OF INCREASING CONTRAST SENSITIVITY OF TELEVISION CAMERAS (AUTHOR'S ABSTRACT)
A. M. Khalfin *In its* Quality of the Phot. Image 11 Mar. 1965 p 216–217 (See N65-26508 15-14)

Proposed is a method for reducing the contrast sensitivity threshold for an ideal camera tube in which the shot effect of photocathode emission is the sole source of noise, and the characteristics of the camera are linear. Considered in the analysis are the electron charge, the linear dimension of one element on the photocathode, the illuminance of the picture in its brightest section, the reduced integral sensitivity of the photocathode, and the storage time. Calculations indicate that the contrast sensitivity threshold can be much less than the threshold of visual contrast sensitivity. It is further shown that the same is true of the contrast sensitivity threshold of large objects, as in the case of real camera tubes having nonlinear characteristics. S.C.W.

N65-26532 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE QUALITY OF IMAGE CONVERTER SCREEN IMAGES
V. R. Muratov and Ye. V. Nilov *In its* Quality of the Phot. Image 11 Mar. 1965 p 228–235 refs (See N65-26508 15-14)

A theoretical analysis of the optimal characteristics of the resolving power and other elements of image converters, which focuses on the development of optical apparatus equipped with image converters having the capacity to transmit fine image details, is reported. Results show that in order to obtain the complete characteristic curve representing the capacity of an image converter to transmit fine image details, it is first necessary to know the following quantities: the visual resolving capacity for various distances from the photocathode center; the frequency-contrast characteristic of the converter and its variation with increase of distance from the photocathode center; and the relationship between the values of limiting contrast and the line frequency of the target used for estimating the efficiency of the converter. Expressions used in the experimental determination of these factors are included. Also described is a device which was developed for use in determining the contrast transmission coefficients for an image converter. S.C.W.

N65-26533 Library of Congress, Washington, D. C. Aerospace Technology Div.

GRAIN STRUCTURE OF PHOTOGRAPHIC IMAGES. PROCEDURE OF MEASURING SIGNAL-TO-NOISE RATIO IN PHOTOGRAPHY

S. B. Gurevich, I. I. Breydo, and G. A. Gavrilov *In its* Quality of the Phot. Image 11 Mar. 1965 p 236–245 refs (See N65-26508 15-14)

Reported is a procedure for determining the signal-to-noise ratio of photographic materials, which employs the use of instrumental methods for measuring fluctuations of darkening, and which is based on existing theory concerning the similarity between the granularity of photographic materials and the noise occurring in electric circuits. Presented is a description of a modified microphotometer which was used in measuring the signal-to-noise ratio, and results of an evaluation of the accuracy of the method for two materials, astro plates and diapositive plates, dissimilar in noise. It is shown that measured and calculated values of the signal-to-noise ratio in both materials were in good agreement. Results of measurements on several photographic materials by scanning the specimens with a slot having an area of 100 microns, are also included. The influence of scratches and contaminations on the accuracy of measurements on fine-grain, high-contrast materials, is discussed. S.C.W.

N65-26534 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE FUNCTION OF THE NUMBER OF DEVELOPED GRAINS AND DEPENDENCE OF PHOTOGRAPHIC NOISE ON OPTICAL DENSITY OF DARKENING

S. B. Gurevich, I. I. Breydo, and G. A. Gavrilov *In its* Quality of the Phot. Image 11 Mar. 1965 p 247–251 refs (See N65-26508 15-14)

Presented is a study of the function of the number of developed grains and the dependence of photographic noise on the optical density of darkening, which focuses on determining which of the functions of distribution (Poisson, Gaussian, or binomial) provides a better description of the actual distribution of developed grains. Results of measurements on Astro and diapositive photographic plates, and motion-picture film, showed that the dependence of noise of photographic materials on the optical density is adequately described by the binomial distribution, and is not in agreement with the functions of distribution of Poisson and Gauss, since the binomial approximations more closely demonstrated the true function of distribution of deviation of the number of developed grains from the average value. S.C.W.

N65-26535 Library of Congress, Washington, D. C. Aerospace Technology Div.

ON THE ACCURACY OF MEASUREMENT OF THE MACROGRANULARITY OF DARKENINGS BY THE PHOTOGRAPHIC PROJECTION METHOD

T. M. Levenberg *In its* Quality of the Phot. Image 11 Mar. 1965 p 252–258 refs (See N65-26508 15-14)

An evaluation of the accuracy of the photographic projection method of determining the macrogranularity of negatives is presented, which focuses on inherent problems associated with the accuracy of human evaluations of granulograms, and granulometer defects. Presented are results of an analysis of several granulograms, which were obtained from negatives produced on three types of motion-picture negative film, and which were printed with a technically improved granulometer. It was shown that systematic discrepancies between absolute values of the granularity factor occurred on the average of 15%, due to individual differences in visual acuity; and differences in the degree of perceived granularity, which was complicated by the limited scale of magnification. It was further demonstrated that the random errors of evaluation of different negatives by individual observers did not exceed 8%. To achieve better reproducibility of results, it is recommended that the relative values of the granularity factor be utilized. S.C.W.

N65-26536 Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATION OF PHOTOMETRIC EQUIVALENT OF DARKENINGS

V. P. Baranova and Yu. N. Gorokhovskiy *In its* Quality of the Phot. Image 11 Mar. 1965 p 259–276 refs (See N65-26508 15-14)

Presented is a study of the ratio of the surface concentration of silver in the photographic negative to the diffuse optical density of the negative (photometric equivalent of the negative); the influence of the degree of development of a photographic material on the value of the photometric equivalent; and the correlation between the photometric equivalent and the average diameter of silver grains forming the negative. Results of an investigation of four black-and-white negatives, which were subjected to two types of developers, showed that: (1) for all four negatives undergoing varying, but constant, periods of development, the values of the photometric equivalent decreased with increasing optical density, and that this relationship was most marked in film having the largest silver grains; (2) when the negative density was changed, by changing the exposure, the magnitude of the photometric equivalent decreased to the same degree for each film; (3) variation of the degree of development of photographic materials with different developers exerts a substantially different influence on the magnitude of the photometric equivalent; and (4) correlation between photometric equivalent and average dimensions of silver grains forming the negative, is satisfactorily described by empirical linear equations. S.C.W.

N65-26537 Library of Congress, Washington, D. C. Aerospace Technology Div.

DETERMINATION OF MACROGRANULARITY OF POSITIVE MONOCHROMATIC COLORED FIELDS BY THE PHOTOGRAPHIC PROJECTION METHOD

T. M. Levenberg and L. K. Lokutsiyevskaya *In its* Quality of the Phot. Image 11 Mar. 1965 p 277–285 refs (See N65-26508 15-14)

Described is a procedure for determining the macrogranularity of positive monochromatic colored fields, which is based on the use of a compensation light-filter which reduces the spectral light-sensitivity curve of panchromatic photographic material to the visibility curve of the human eye. The method, which is a modification of the photographic projection method, was developed as a possible solution to inherent problems of macrogranularity in the hydrotype method of color-film printing and the multilayer process. Results of a comparative study of two phototechnical films showed that the granularity values, as determined by this method, were in good agreement with the macrogranularity of colored fields observed in practice. It is further concluded that the proposed method may be considered valid not only for colored matrices, but also for monochromatic images on base-film and single-layer coatings of multilayer positive film, since the absorption curves of the dyestuffs are sufficiently close in these instances. S.C.W.

N65-26538 Library of Congress, Washington, D. C. Aerospace Technology Div.

PHOTOGRAPHIC MATERIALS AND THEIR CHEMICO-PHOTOGRAPHIC PROCESSING FROM THE IMAGE QUALITY VIEWPOINT. IMAGE FORMING OF FINE DETAILS DURING DEVELOPMENT IN VARIOUS TYPES OF DEVELOPERS

S. G. Bogdanov and A. L. Shamsheva *In its* Quality of the Phot. Image 11 Mar. 1965 p 286–300 refs (See N65-26508 15-14)

A study of the influence of several developers on the formation of photographic images is presented, which focuses on determining the degree to which the flatness of the image depends on the selection of the developer (light-sensitivity vs. corona scattering), and the development conditions under which an image can be obtained which, considering the exposure scale, will most accurately reproduce the dimensions of the object photographed. Studied were motion picture, fine-grained, and panchromatic film, which were subjected to different concentrations of several developers of the following constituents: metol, anhydrous sulfite, hydroquinone, anhydrous soda, sodium hydroxide, potassium iodide, and potassium bromide. It was shown that: (1) independent of the composition of the developers, the dimensions of the scattering corona in the layer were identical to equal values of light sensitivity, (2) the most accurate reproduction of the dimensions of elements of the optical image of the photographic subject and the maximum resolution frequency of a one-dimensional lattice are achieved at one and the same exposure, (3) the level of the development edge effects depends on the value of the oxidation-reduction buffering of the developer and on the content of bromide in it, and (4) during development in unbuffered developers under certain conditions of exposure, the density in the image of fine details can be significantly greater than in an image of larger detail. S.C.W.

N65-26539 Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATION OF THE PHOTOGRAPHIC PROPERTIES OF LIGHT-SENSITIVE MATERIALS SUBJECTED TO FAST DEVELOPMENT

V. A. Veydenbakh and P. I. Levina *In its* Quality of the Phot. Image 11 Mar. 1965 p 301–307 refs (See N65-26508 15-14)

Based on a previous investigation of the effect of developing agent concentrations on the process of fast development, in which the use of a metol-hydroquinone developer containing metol and hydroquinone in molar concentrations at a ratio of 1:35 was proposed; a study is reported on the applicability of a modified developer to commercially produced motion picture and aerial film processing. Results of an investigation of several photographic film negatives showed that: (1) light sensitive materials can be divided into 5 groups according to the quantity of silver halide contained in the emulsion layer, and that grouping of the photographic materials allows the rational selection of materials designated for fast development in relation to conditions of their exposure and intended uses; (2) the greatest difference in light sensitivity during fast and normal development, as compared to identical contrast coefficient values, was observed during the use of highly sensitive materials; also, as a rule the resolution capability does not depend on the method of processing; and (3) the quality of the photographic image obtained during fast processing of motion picture films is not inferior to the quality of the image obtained during normal processing. S.C.W.

N65-26540 Library of Congress, Washington, D. C. Aerospace Technology Div.

COMPARISON OF DIFFERENT METHODS OF DETERMINING THE LIGHT SCATTERING AND REFLECTION IN THE EMULSION LAYER (AUTHOR'S ABSTRACT)

G. G. Gribakin, G. A. Istomin, and Z. L. Petrushkin *In its* Quality of the Phot. Image 11 Mar. 1965 p 308–309 (See N65-26508 15-14)

A comparative study of existing and proposed methods of measuring the individual and combined effects of light scattering and reflection in black-and-white and color photographic motion picture film, is presented. Proposed is a method for measuring the combined effects of these two factors, which consists of a series of isolated black bands, 12.5, 25, 50, and 100 microns wide, placed on a light background. Results indicate that, the combined effects of light scattering in the layer and its reflection from the sublayer should be considered in determinations of the physical characteristics of photographic materials. Also proposed is the use of a graph-analytic method, for the separate determination of light scattering in the layer and the reflection corona. S.C.W.

N65-26541 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE USE OF THE DIFFUSIOMETRIC METHOD OF DETERMINING THE SHARPNESS OF PHOTOGRAPHIC IMAGE IN THE TECHNOLOGY OF PREPARATION OF THIN-LAYERED MOTION PICTURE FILMS

V. L. Zelikman, F. S. Sherman, V. A. Dmitriyeva, and Ye. B. Kondrat'yeva *In its* Quality of the Phot. Image 11 Mar. 1965 p 310–321 refs (See N65-26508 15-14)

Presented is a study of the applicability of the diffusiometric method of determining the sharpness of photographic images, to the selection of optimal conditions for synthesizing photographic emulsions having low densities of silver halide. Also considered were optimal conditions for the technological development of thin-layered motion picture films with increased sharpness of the photographic image. Presented are results of an investigation of panchromatic negative motion picture film of varying degrees of dispersion, which were covered with varying densities of silver halide; and a nonammonia motion picture negative film of high light sensitivity. Included are results of simultaneous studies of the effect of the total optical density of the anticoronal base dye on a film having an average microcrystal size of 0.3 microns, and the effect of the same type of emulsion on isopanchromatic motion picture film. The primary advantages of this method, over existing methods, are discussed. S.C.W.

N65-26542 Library of Congress, Washington, D. C. Aerospace Technology Div.

EMULSION FACTORS DETERMINING THE RESOLUTION CAPABILITY OF THE LIGHT-SENSITIVE LAYER

I. R. Protas, P. T. Sidorenkova, and T. V. Ryzhkova *In its* Quality of the Phot. Image 11 Mar. 1965 p 322–328 refs (See N65-26508 15-14)

Presented is a study of the photographic properties (resolution capabilities) of emulsions consisting of plate crystals homogeneous by size, which were separated by the partial sedimentation method. It is shown that the resolution capability of even the most lowly-dispersed fractions is higher than the resolution capability of the initial, highly dispersed emulsion. Comparative studies of the kinetics of chemical maturing of the initial and fractionated emulsions showed that fractionated emulsions reach optimal values of light sensitivity in a shorter time than initial emulsions. Included are data on the distribution of both types of emulsion crystals, and their dispersion and sensitometric properties. S.C.W.

N65-26543 Library of Congress, Washington, D. C. Aerospace Technology Div.
LIGHT SCATTERING IN EMULSION LAYERS AND THEIR RESOLUTION CAPABILITY
P. Kh. Pruss *In its* Quality of the Phot. Image 11 Mar. 1965 p 329–338 refs (See N65-26508 15-14)

1. The effect of the form of silver halide microcrystals of the photographic layers is investigated on the scattering of light by them. It was determined that plate-type thin crystals scatter less light than the thicker spherical crystals which are equal to them in projection area. 2. The effect of the silver halide microcrystalline form on the resolution capability of the photographic layers is investigated. It is shown that at identical microcrystal distribution curves according to the projection area, the photographic layers with plate microcrystals possess a greater resolution capability than layers with spherical layers. Author

N65-26544 Library of Congress, Washington, D. C. Aerospace Technology Div.
KINETICS OF SUCCESSIVE REACTIONS IN THE PHOTOGRAPHIC PROCESS AND THE SHARPNESS OF THE IMAGE
I. B. Blyumberg and L. I. Fedoruk *In its* Quality of the Phot. Image 11 Mar. 1965 p 339–344 refs (See N65-26508 15-14)

1. The question of the kinetics of successive reactions is examined. It is shown that in many cases the kinetics of the secondary reaction determines the course of the primary. 2. If as a result of the successive reactions a photographic image appears, then its sharpness depends on the kinetics of the secondary reaction. 3. The kinetics of the tanning of gelatin by the oxidation form of pyrogallol and trivalent chromium salts is investigated, as well as the formation of dyes in the layers of a multilayered film. Author

N65-26545 Library of Congress, Washington, D. C. Aerospace Technology Div.
INVESTIGATION OF THE CORRELATION BETWEEN THE RESOLUTION CAPABILITY AND MACRO-GRAININESS OF BLACK-AND-WHITE PHOTOGRAPHIC MATERIALS
Yu. N. Gorokhovskiy and P. Kh. Pruss *In its* Quality of the Phot. Image 11 Mar. 1965 p 345–350 refs (See N65-26508 15-14)

Presented are results of a comparative study of the relationship between the resolution capability and macrogranularity of black-and-white photographic materials. It is demonstrated that there is a decrease in granularity as resolution capability increases, which confirms the hypothesis that no definite association exists between the resolution capability of the emulsion layers and the macrogranularity factor of developed photographic materials. Also presented are data which show the influence of these factors on emulsion coating conditions. S.C.W.

N65-26546 Library of Congress, Washington, D. C. Aerospace Technology Div.
RESOLUTION CAPABILITY OF PHOTOGRAPHIC LAYERS EXPOSED BY NUCLEAR RADIATIONS
A. L. Kartuzhanskiy and B. P. Soltitskiy *In its* Quality of the Phot. Image 11 Mar. 1965 p 351–361 refs (See N65-26508 15-14)

The resolution capability of different photographic layers during their exposure by alpha- and beta-particles is investigated. It is shown that for alpha- as well as for beta-particles, the resolution capability decreases with an increase in energy of the particles, i.e., their path in the emulsion layer. With regard to the action of alpha-particles released by natural radioactive elements, the resolution capability is generally lower than with regard to the action of beta-particles of any naturally radioactive isotopes. The relationship of the resolution capability to a number of factors is the same for action of light and for the action of particles. The resolution capability increases with an increase of the dispersion of the solid phase and AgHal concentration in the emulsion, and during the decrease of the emulsion layer thickness. With the increase of the optical density of the resolvogram (because of exposure or development) the resolution capability passes through a maximum. Author

N65-26547 Library of Congress, Washington, D. C. Aerospace Technology Div.
FORM AND SIZES OF THE SILVER BROMIDE CRYSTALS FORMED AT DIFFERENT pH VALUES OF THE DISPERSION MEDIUM
I. R. Protas and V. M. Ivanova *In its* Quality of the Phot. Image 11 Mar. 1965 p 362–367 refs (See N65-26508 15-14)

The dispersion properties of emulsions and the thicknesses of the emulsion crystals are investigated, which are formed at different pH of the dispersion medium created by sodium hydroxide and acetic acid. It was found that emulsification in the presence of sodium hydroxide (pH $\cong$ 10.5) results in an increase in the thickness of the AgBr crystals, however to a lesser degree than in the presence of ammonia. It was also found that the thicknesses of the crystals formed in an acid medium (pH $\cong$ 3.5) are of that same order as the thicknesses of crystals of the usual non-ammonia emulsions. It is shown that the increase in the pH of the medium by sodium hydroxide during emulsification does not affect the average size of the crystals and the dispersion but decreases the number of crystals in a unit volume because of the increase of the crystal thickness. Author

N65-26553# Massachusetts Univ., Amherst. Polymer Research Inst.
AN AUTOMATIC X-RAY DIFFRACTOMETER FOR POLE-FIGURE ANALYSIS OF POLYMER ORIENTATION
C. Richard Desper 15 Jan. 1965 90 p refs
(Contracts AT(30-1)-3003-2; Nonr-3357(01))
(ONR-TR-78; AD-464059)

An automated X-ray diffractometer has been designed and built to obtain pole figure data on polymeric samples. The pole figure goniometer is automatically driven, in a prefixed, constant-increment program, by two pulse motors, allowing the operator to determine the complete distribution pattern for a given h k l plane automatically. The results are punched out on IBM cards; two programs have been written to process this data on the IBM 1620 computer. The first program computes the X-ray intensity at each sample orientation, corrected for absorption, polarization, background, and incoherent scattering. The second program uses this intensity data to obtain locations of constant-intensity contour lines. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-25767# Battelle Memorial Inst., Columbus, Ohio.
THE DEVELOPMENT OF TECHNIQUES TO MEASURE THE DYNAMIC FILM THICKNESS AND FILM PRESSURE IN JOURNAL BEARINGS LUBRICATED WITH LIQUID POTASSIUM Quarterly Progress Report, 15 May–14 Aug. 1964
D. R. Grieser, J. H. Flora, A. H. Leatherman, and C. M. Allen Sep. 1964 33 p refs
(Contract AF 33(615)-1134)
(AD-460892)

The program to develop techniques for the static and dynamic measurement of liquid-potassium-lubricated journal-bearing film thickness, film pressure, and film extent has continued. The first phase, paper evaluations of a number of potential techniques to accomplish the program objectives, was completed. Of the techniques studied, an eddy-current and magnetic-inductance method were selected as being most favorable for the film-thickness and film-extent measurements. A device based on the Villari effect is being designed for measurement of the potassium-film pressure. The laboratory evaluations are approaching completion, and the designing of prototype transducers and supporting instrumentation has been started. Author

N65-25793# Kaysam Corp. of America, Paterson, N. J.
PRODUCTION ENGINEERING MEASURE FOR MANUFACTURE OF METEOROLOGICAL BALLOONS TYPE ML-541 ( )/UM Final Report, 19 Apr. 1962–31 Jan. 1965
Murray Miner [1965] 99 p
(Contract DA-36-039-SC-85988)
(AD-612608)

Hand techniques were investigated and a conical ring method for joining the head and tail balloons was selected as a basis for the design of the assembly machine. Various types of dipping machines were examined. A one cylinder hydraulically operated turntable was chosen for its simplicity, dependability and safety of operation. A conveyorized inflation drying system was designed and installed to inflate and dry head and tail balloons. Process specification for the ML-541 ( )/UM meteorological balloon are included. Manufacturing equipment, dipping forms, necessary materials and procedures required to fulfill the pilot run, and pilot production line are described. Inspection positions and their expected yields are given. Author

N65-25928# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TECHNICAL REPORT: STRUCTURAL MECHANICS. AN INVESTIGATION OF UNREINFORCED PLASMA-SPRAYED CERAMIC-COATED REFRACTORY METALS SUBJECTED TO 4000° F
E. H. Nickell Feb. 1965 24 p
(LMSC-6-75-65-7)

An experimental investigation of possible unreinforced thermal protective systems for hypervelocity atmospheric reentry vehicles is presented. Six coatings and four substrates are screened by subjecting them to a 4000° F front face temperature and a very low impact energy of approximately 13.6 ft-lbs (18.5 joules). The six ceramic coatings were four oxides: zirconia, thoria, beryllia, and hafnia, and two borides: thorium and hafnium. The four substrates were columbium, tungsten, tantalum, and pyrolytic graphite. The investigation shows that thin ceramic coatings are satisfactory for reentry heat shields but unreinforced coatings are not satisfactory. Hafnia on columbium gave the best thermal protection when exposed for 10 minutes at a front face temperature of 4000° F. The boride coatings resisted impact loading better than the oxide coatings but both require reinforcement. Author

N65-25945# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR MECHANIZATION OF HIGH RELIABILITY CAPACITORS Quarterly Report, 30 Sep.–30 Dec. 1964
J. H. D. Folster, P. M. Kennedy, and G. E. Walters [1964] 16 p
(Contract DA-36-039-AMC-01460(E))
(QR-8; AD-613365)

Work on the production design engineering and design of pilot line equipment continues. Of the 29 major subassemblies to be used in the mechanized high-reliability capacitor assembly operation, 13 are complete and another 15 are in various stages of production. The remaining assembly is currently being designed. Author

N65-25975# General Bronze Corp., Garden City, N. Y.
DEVELOPMENTAL PROGRAM FOR THE FABRICATION AND TESTING OF LIGHTWEIGHT WAVEGUIDE Engineering Report, Phase II, 8 Aug. 1964–15 Mar. 1965
[1965] 30 p
(Contract NObsr-85320)
(AD-613064)

Studies are presented on a program to fabricate and test lightweight serpentine waveguide structures. A single convolution of a serpentine waveguide was simulated and tested. Testing revealed the presence of higher modes than the fundamental mode of transmission which would have a deleterious effect on the array pattern. A new configuration in the form of a uniform helical waveguide is presented as a possible solution for the electronically steerable arrays. A lightweight model of a serpentine section was completed. R.N.A

N65-25998*# Pratt and Whitney Aircraft, Middletown, Conn.
INVESTIGATION OF CAVITATION DAMAGE OF MECHANICAL PUMP IMPELLERS OPERATING IN LIQUID METAL SPACE POWER LOOPS Quarterly Progress Report No. 3, Jan. 2–Mar. 31, 1964
R. S. Kulp and J. V. Altieri 15 Apr. 1964 21 p
(Contract NAS3-2541)
(NASA-CR-54032) CFSTI: HC $1.00/MF $0.50 CSCL 13K

Water testing of the turbopump was completed. Data showed good agreement with the impeller tests previously conducted. Also, the five flow rates investigated during the impeller tests were repeated for evaluation of the cavitation performance of the turbopump. The pump scroll losses were very low and closely approximated the losses of the vaneless diffuser in the previous impeller tests for noncavitating operation. Scroll effects were more evident in cavitation testing for the higher flow rates. Further, orifice-sizing calculations were completed, based on the operating conditions for the liquid-metal endurance test. A single orifice, machined and tested in water, cavitated violently at the operating point producing severe vibration of the test stand. Two orifices in series were found to provide a satisfactory solution to the orifice cavitation problem. E.E.B.

N65-26010# Army Materials Research Agency, Watertown, Mass.
ULTRASONIC SPECTROSCOPY OF STEEL
Otto R. Gericke Dec. 1964 22 p refs
(AMRA-TR-64-44; AD-614113)

An electronic instrument has been developed which makes it possible to obtain the ultrasonic attenuation spectrum of a solid material. The spectroscope employs the ultrasonic pulse-echo test technique and is equipped with a single ultrasonic transducer which is used for both transmission and reception of ultrasonic signals. Special electronic circuitry provides improved uniformity of transducer frequency response with the result that a frequency range of 3 to 12 mc can be covered. The

ultrasonic spectroscope has been applied to examine microstructures of steel specimens differently heat treated to produce grain size variations. Experimental results indicate that the amplitude distribution in the ultrasonic spectrum is strongly influenced by specimen microstructure. It is possible to discriminate between grain sizes varying from 2 to 8 (ASTM scale) on the basis of ultrasonic attenuation spectra observed. Compared with conventional multiple-back-echo attenuation testing, the spectroscopic method offers the advantage that measurements can be carried out much faster. A further feature of the technique is that the back-echo amplitude is not involved in the measurement and thus can be used as a control indication to continuously monitor overall equipment sensitivity and transducer coupling conditions. Author

N65-26021*# Huyck Corp., Milford, Conn. Huyck Metals
PREPARATION AND EVALUATION OF FIBER METAL NICKEL BATTERY PLAQUES Third Quarterly Progress Report, Feb. 1–Apr. 30, 1965
J. L. Bidler and J. I. Fisher [1965] 18 p refs
(Contract NAS3-6006)
(NASA-CR-54414; Huyck-805-(F3-25)) CFSTI: HC $1.00/MF $0.50 CSCL 13H

An experiment to more clearly define the effect of fiber size upon internal surface area and pore size of nickel fiber metal plaques has been completed by separating the finest fibers from AX1 nickel fiber. Two techniques were used for separation. The first, a laboratory technique, separates according to fiber length. The fine, short fibers obtained by this method resulted in a plaque with an increased internal surface area and smaller pores at the expense of porosity. The second method, a production technique, separates according to fiber diameter. Plaques made from this material have increased internal surface area with no significant change in pore size or porosity. Sintering parameters of 1900 ± 15° F for 20 minutes in dry hydrogen have been established for nickel fiber metal battery plaques. This processing results in maximum internal surface area and tensile strength and minimum electrical resistivity without significantly increasing the density. Air permeability determinations of internal surface area have been supplemented by a modified B.E.T. Krypton technique. A measurement of AX1 nickel fiber sintered at 1900 ±15° F for 20 minutes indicated an internal surface area of 590 cm^2/gm by the B.E.T. method as compared with 370 cm^2/gm for the air permeability calculation. Plaques of AXI and AX2 nickel fiber metal have been produced at a thickness of 0.028 ±.001 and sintered from 20 minutes in dry hydrogen. Plaque classification tests have been initiated and preliminary results compare favorably with the results obtained from the sintering study. Author

N65-26045*# Midwest Research Inst., Kansas City, Mo.
EXTREME VACUUM TECHNOLOGY INCLUDING CRYOSORPTION, DIFFUSION PUMP AND PRESSURE CALIBRATION STUDIES Quarterly Status Report No. 7, 1 Feb.–1 May 1965
Paul J. Bryant and Charles M. Gosselin [1965] 17 p refs
(Contract NASr-63(06); MRI Proj. 2675-P)
(NASA-CR-63239) CFSTI: HC $1.00/MF $0.50 CSCL 13K

A systematic study has been conducted to determine the effectiveness of an optically dense chemical trap in reducing the gaseous contamination of UHV systems by an oil diffusion pump using DC-705 pumping fluid. Three trap temperature conditions were studied. Two of these conditions were determined by submerging the experimental trap into a bath of either liquid nitrogen or dry ice and acetone. The third temperature was determined by ambient laboratory conditions. The data collected by means of a sensitive partial pressure analyzer indicated that a significantly lower level of contamination was achieved by cooling the chemical trap to even −78° C from room temperature. Data were also taken of the trap operating without chemical. Comparison of these sets of data indicates that a significant increase in trapping efficiency can be realized when chemicals are used. The greatest improvement over the nonchemical conditions was noted at the dry ice and acetone slurry temperature. A consideration of these results suggests that reasonably good trapping of UHV systems can be achieved by employing mechanically refrigerated chemical traps above oil diffusion pumps. Author

N65-26072# Midwest Research Inst., Kansas City, Mo.
FRICTION AND WEAR BEHAVIOR OF SOLID FILMS Summary Technical Report, 1 Dec. 1963–1 Dec. 1964
Paul J. Bryant Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1964 27 p refs
(Contract AF 33(657)-10122)
(AFML-TR-65-5; AD-614242)

Two current phases of research and the initiation of a third phase are described below. The phases consist of: (1) a study of cleavage energies and stress-relaxation effects for graphite in air, vacuum, and pure environments of relevance to lubrication phenomena; (2) measurements of the shear strength of graphite and the physical mode of failure under shearing motion; and (3) a detailed study of friction and wear process, including wear particle size measurements, in the pure relevant environments for graphite lubrication. The first phase has shown, from both theory and experiment, an unusually high binding energy for graphite. This high energy has been identified as the real reason for graphite's failure to exhibit intrinsic lubrication. The second phase has confirmed the conclusions drawn from the first study by showing a high shear strength for graphite. The third phase promises to give correlations between the basic properties of graphite, such as binding energy, and effects which are observed during actual frictional tests. Thus, all of the results from cleavage measurements, stress relaxation in various environments, and shear strength measurements will be correlated with the friction and wear studies to give a better understanding of lamellar solid lubrication. Author

N65-26087# Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT Interim Report, Feb. 1–Apr. 1, 1965
F. H. Simpson and L. M. Stejskal [1965] 17 p
(Contract NOw-64-0194-f)
(IR-6; AD-462748)

Specimens made from cubical shaped particles had better oxidation resistance and higher compressive strength than those made using plate-like particles. Specimens made using rectangular shaped particles with one axis elongated have nearly comparable oxidation and compressive properties to those made from cubical particles and have higher flexural strength. Flexural strength, compressive deformation and weight loss due to oxidation increase with increasing metal content in the composite. The rate of weight loss due to oxidation increases with increasing metal content. Results from hot pressing, isostatic pressing and warm pressing experiments are summarized. Substantial improvements in sintering of the composite have not been realized either by increasing pressure in the vacuum furnace or through use of wet hydrogen. Yielding in flexural specimens prior to ultimate failure was obtained in specimens sintered in wet hydrogen and not in those sintered in vacuum. Author

N65-26096# Watervliet Arsenal, N. Y. Benet R & E Labs.
BORE EVACUATOR VALVE TEST, CANNON 155MM HOWITZER, M126
J. M. Giesey, E. R. Lawson, and R. L. Rosenblum Aug. 1964 73 p
(WVT-11-6412; AD-606663)

The limited life of Bore Evacuator Valve Assembly 8769384 during firing tests led to the authorization of a test program to find a valve assembly with a longer life. The cost of testing in the gun (155mm How. M126) made it economical to build a test apparatus which simulated the weapon. The test program was the basis for the incorporation of valve assembly 8769531 into the weapon system. A comparison of the strain level of the modification is presented. The life of the then current production valve assembly and the new production valve assembly under different charges is also given. Author

N65-26202# Sulzer Brothers, Ltd., Winterthur, (Switzerland).
SULZER TECHNICAL REVIEW, VOLUME 44, NUMBER 1, 1962
[1962] 53 p refs

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N65-26205# Joint Publications Research Service, Washington, D. C.
SOVIET CONFERENCES ON METALLURGICAL PROBLEMS
8 Jun. 1965 59 p Transl. into ENGLISH from Russian periodicals
(JPRS-30487; TT-65-31198) CFSTI: $3.00

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N65-26207 Joint Publications Research Service, Washington, D. C.
FIFTH ALL-UNION SCIENTIFIC AND TECHNICAL CONFERENCE ON THE USE OF HF CURRENT IN ELECTROTHERMICS
In its Soviet Conf. on Met. Probl. 8 Jun. 1965 p 8–10 Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 3, Mar. 1965 p 61–62 (See N65-26205 15-15) CFSTI: $3.00

A series of research reports presented at a conference on the application of high frequency current in electrothermics is presented and include heat treatment in induction heating, metallography of electrothermic treatment, high frequency currents in metal welding and electrometallurgy, induction heating in forging and rolling production, high frequency heating of nonconducting materials, and the development and production of high quality electrothermic equipment. R.N.A.

N65-26209 Joint Publications Research Service, Washington, D. C.
CONFERENCE ON ELECTRODES FOR RESISTANCE WELDING MACHINES
Ya. A. Fedorenko *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 20–21 Transl. into ENGLISH from Automat. Svarka (Kiev), no. 4, Apr. 1965 p 78 (See N65-26205 15-15) CFSTI: $3.00

A short outline of the present state and future development of electrode production for contact welding processes is given, and some aspects of alloying electrode materials are presented. G.G.

N65-26210 Joint Publications Research Service, Washington, D. C.
CONFERENCE ON IMPROVING QUALITY AND RAISING THE LEVEL OF MECHANIZED WELDING OPERATIONS
Ye. D. Kafitin *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 22–24 Transl. into ENGLISH from Automat. Svarka (Kiev), no. 4, Apr. 1965 p 78–79 (See N65-26205 15-15) CFSTI: $3.00

Several problems of increasing the quality of welded assemblies by manual arc and gas welding mechanization are briefly outlined. Welding in carbon dioxide gas and an exposed arc was found to be most promising. G.G.

N65-26211 Joint Publications Research Service, Washington, D. C.
SECOND ALL-UNION CONFERENCE ON WELDING DISSIMILAR METALS
V. R. Ryabov *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 25–29 Transl. into ENGLISH from Automat. Svarka (Kiev), no. 4, Apr. 1965 p 79–80 (See N65-26205 15-15) CFSTI: $3.00

Studies were made on welding of titanium with aluminum aluminum with stainless steel, copper with steel, copper with aluminum, molybdenum with steel and zirconium alloy, etc., and the physical and chemical principles of the various welding processes are briefly discussed. Formulas for the quantitative evaluation of the formation of a union of dissimilar metals are reported that show good agreement between experimental and calculated data in the example of a titanium–aluminum pair. G.G

N65-26212 Joint Publications Research Service, Washington, D. C.
WELDERS CONFERENCE IN YAROSLAVL'
V. A. Asriyants *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 30–36 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 4, Apr. 1965 p 45 (See N65-26205 15-15) CFSTI: $3.00

Main directions in development of science and technology in welding are briefly discussed. The goal is an increased level of mechanization of welding operations, a higher production of welded structures, and an improved material and technical supply for welding processes. G.G.

N65-26213 Joint Publications Research Service, Washington, D. C.
ALL-UNION SEMINAR ON COMPRESSED-ARC WELDING AND CUTTING
K. V. Vasil'yev *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 37–40 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 3, Mar. 1965 p 44–45 (See N65-26205 15-15) CFSTI: $3.00

The diversity of the various technological possibilities for compressed arc welding of materials is discussed. Of interest is the possibility of increasing the gas-electric cutting rate for cutting steels through an increase in arc power, and the application of compressed air in beading along a grid layer. The compressed arc method was recommended for cutting, and also welding of thin-sheet stainless steel and aluminum. G.G.

N65-26280# Oklahoma Univ. Research Inst., Norman.
BEARING AND LUBRICANT PROBLEMS Final Report, 1 Sep. 1962–31 Aug. 1963
Darrel G. Harden 3 Feb. 1964 68 p
(Contract AF 34(601)-14089)
(AD-429247)

Three general and eight specific problems are presented in the development of bearings and lubricants. The general problems include the development of a petroleum base lubricant for KC-97 and B-50 aircraft superchargers with improved viscosity-volatility and viscosity-temperature characteristics, development of improved turbosuperchargers storage preservatives, and testing of a synthetic lubricant used in a constant speed drive system. The specific problems discussed are the suitability of grade 1100 aviation oil after contamination with aviation gasoline, determination of a suitable lubricant for use in ram air turbines and for lead screws of missile attitude stands, inspection of J79/F104 Teleflex box bearings, engineering study of ballbearings P/N VI-224248, inspection of bearings from air turbine assembly P/N 202280 and 202290, investigation of pour point of refrigerator compressor oils, freezing prevention in an evaporative heat exchanger by using constant boiling mixtures, and determination of a suitable high temperature lubricant for swivel joints in the hot air bleed line of KC-97 superchargers. R.N.A.

N65-26285# Naval Applied Science Lab., Brooklyn, N. Y. Material Sciences Div.
NARROW-GAP WELDS IN 2" HY 80 STEEL Technical Memorandum No. 12
D. H. Kallas [1964] 17 p
(USNASL-9110-P-1J; AD-461819)

The properties of narrow-gap welds made in the flat welding position were investigated. Two explosion crack starter and three explosion bulge two inch thick HY 80 steel butt weldments fabricated by the narrow-gap welding process were subjected to explosion bulge tests. Test performance was satisfactory and the weldment behavior approximated that of an unwelded base plate. However, scattered porosity and internal discontinuities were noted in macrosections of the weldments. Results show that the narrow-gap welding process in the flat position can produce welds with explosion bulge properties equal to those of HY 80 weldments. R.N.A.

N65-26303# Sperry Microwave Electronics Co., Clearwater, Fla.
PRODUCTION ENGINEERING MEASURE YIG SPHERES AND LIMITERS Fifth Quarterly Progress Report, 29 May–29 Aug. 1964
J. E. Andrews and L. R. Hodges, Jr. [1964] 17 p
(Contract DA-36-039-AMC-01477(E))
(SJ-222-0045-5; AD-609661)

A new method of casting abrasive rings for the tunnel air races has been devised, resulting in greater productivity and reduced down time. The new sphere encapsulation and alignment process has been fully developed and tested. This process yields greater speed and accuracy, resulting in an increased production capability. The second delivery of limiter engineering samples was shipped during this reporting period. Design goal characteristics were not accomplished in all units. Machined and purchased parts are being prepared for the fabrication of the preproduction units. Test specifications and procedures are being drawn up for use in testing these units. YIG material has been fired to demonstrate reproducibility and to study the distribution of magnetization values in gallium substituted material. Satisfactory results were indicated in both cases. Author

N65-26305# Burndy Corp., Norwalk, Conn. Electronic Products Dept.
PRODUCTION ENGINEERING OF TRIAXIAL PULSE CONNECTORS Consolidated Report, 16 Dec. 1962–30 Sep. 1964
Maxwell E. Peel 5 Oct. 1964 36 p
(Contract DA-36-039-SC-85964)
(AD-609395) CFSTI: $2.00

A continuing study of triaxial pulse connector designs leading to economical production is presented. Engineering samples of connector assemblies were tested and evaluated. Design modifications were made to assure proper termination of the first shield and proper elimination of air voids at the mating surfaces. Connector assembly samples were also tested and evaluated. Corona characteristics after temperature cycling indicated a degree of cable degradation. R.N.A.

N65-26306# Bendix Corp., Baltimore, Md. Friez Instrument Div.
ML-419 THERMISTOR P.E.M. Final Engineering Report, Jan. 1, 1963–Aug. 31, 1964
J. T. George and F. D. De Marco [1964] 50 p
(Contract DA-36-039-AMC-01465(E))
(AD-608963) CFSTI: $2.00

A program to improve production techniques for the ML-419 thermistor is reviewed. The problems encountered and the means for solving them are discussed. Thermistor materials, manufacturing processes, and production equipment are described. Test data are presented for all phases of the program. A quality control manual detailing pertinent inspection and quality control information is included. The thermistor meets all military specifications. R.N.A.

N65-26348# National Beryllia Corp., Haskell, N. J.
FABRICATION OF BERYLLIUM OXIDE RADOMES BY PYROLYTIC DEPOSITION Final Engineering Report, 8 Feb. 1963–30 Jun. 1964
George Ferment [1964] 57 p refs
(Contract NOw-63-0412-c)
(AD-608486) CFSTI: $3.00

Research and development work has been conducted with the objective of producing refractory oxide coatings by pyrolytic deposition processes. Beryllium oxide, because of its outstanding physical properties, such as high melting point, high thermal conductivity, low density and electrical characteristics is a strong contender for advanced structural applications. The program was therefore directed toward the preparation of the pyrolytic form of this compound. A hydro-pyrolytic reaction involving thermal decomposition of beryllium halides and oxygen donors such as water vapor was selected for detailed study. The parameters of the dependent and independent variables were partially established and consequently pyrolytic coatings of limited thickness only were produced. The investigation therefore not only demonstrated that pyrolytic beryllium oxide can be prepared but also that continued research is necessary in order to define the controls which must be observed in order to produce the compound in massive form. Author

N65-26406*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT OF THE ALL-WELDED COMMON BULKHEAD Monthly Report, 1–31 Jan. 1965
A. C. Robertson [1965] 14 p
(Contract NAS8-11696)
(NASA-CR-63436; SM-47814) CFSTI: HC $1.00/MF $0.50
CSCL 13H

Progress is reported on the development of a simplified manufacturing technique to simultaneously weld both faces of a common bulkhead from honeycomb sandwich segments for the upper stages of Saturn V. Fatigue tests were postponed due to an equipment failure in the fatigue testing machine. The sandwich panels are complete and ready for welding. The manufacturing sequence, tools, equipment, and procedures for constructing an all-welded segmented common bulkhead are outlined. An inspection plan was initiated and the design of the full-scale bulkhead was continued. The use of the meridian welder to weld the attach rings to the bulkhead was discussed. R.N.A.

N65-26557# Westinghouse Electric Corp., Baltimore, Md. Underseas Div.
INVESTIGATION AND EVALUATION OF EQUIPMENT AND CLOSURES FOR REMOTE CONTROLLED AUTOMATIC WELDER, PHASE I Final Report, 17 Oct. 1961–4 Mar. 1963
A. R. Wilhelm 6 May 1964 131 p
(Contract DA-18-108-CML-6663)
(AD-444813)

Inert-gas shielded arc welding processes suitable for effecting a leakproof welded enclosure on the 500 pound bomb, EX-38, were investigated. Tungsten arc (TIG) and consumable electrode (MIG) welding processes were considered. Variations in test assembly design and material, welding heat, welding speed, and shielding gas flow and mixture were examined. Test assembly designs included butt and tee joint designs, flat disc shaped caps and spun cup shaped caps, and various aluminum alloys. The TIG process was unacceptable because of its inability to produce a weld free of cracks. The MIG process was considered acceptable and although cracks were found they were not as severe as those found in TIG welds. The MIG process was then subjected to a continuity run of fifth double welded test assemblies. The continuity test fulfilled all requirements and although cracks were found they did not cause the welds to leak. Environmental and shock tests were run and no leaks occurred. Subsequent testing was conducted using joint designs that provided complete penetration of the joint, thereby eliminating the joint from the weld. The welds were free of root cracks but they were found in the adjacent base material. R.N.A.

N65-26564# Fairchild Hiller Corp., Bay Shore, N. Y. Stratos Div.
DEVELOPMENT OF GAS-ENTRAINED POWDER LUBRICANTS FOR HIGH-SPEED AND HIGH-TEMPERATURE OPERATION OF SPUR GEARS Technical Report, Jun. 1962–Jan. 1964
S. Wallerstein Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1965 143 p refs
(Contract AF 33(657)-8625)
(AFAPL-TR-65-24; AD-464626)

The feasibility of adapting powder lubricants to the operation of gears during relatively long periods of time under extreme environmental conditions was established. In addition to the lubricant study, parallel investigations were conducted on gear materials and methods of dispensing powder lubricants. Significant achievements of this program are listed below. 1. A pair of 5 DP spur gears, manufactured from M-50 tool steel, had operated for 98-1/2 hours at a speed of 7400 rpm, load of 1000 pounds per linear inch of tooth face, and temperature cycled from room temperature to 900° F. 2. Evaluations of fine-pitch (12/14 DP) superalloy and tool-alloy steel gears were conducted at speeds to 15,500 rpm, temperatures in excess of 1000° F, and loads to 1000 pounds per linear inch of tooth face. 3. All high-temperature evaluations performed during this program used a graphite plus cadmium oxide powder mixture as the gear lubricant. An air carrier was used to deliver the powder to the gear set. Author

N65-26594# Argonne National Lab., Ill. Metallurgy Div.
CONSOLIDATION AND FABRICATION TECHNIQUES FOR VANADIUM-20 w/o TITANIUM (TV-20)
W. R. Burt, Jr., W. C. Kramer, R. D. Mc Gowan, F. J. Karasek, and R. M. Mayfield Feb. 1965 85 p refs
(Contract W-31-109-ENG-38)
(ANL-6928) CFSTI: $3.00

Methods are presented covering a recently developed technology for the consolidation and fabrication of bar, rod, sheet, and high-quality, small-diameter (<5-mm), thin-wall (<0.5-mm) tubing of a V-20w/o Ti (TV-20) alloy. Consolidation included electron-beam (EB) melting of compacted vanadium chip and titanium sponge drip rods, followed by arc-melting of the EB ingot. The arc-cast ingots were broken down by extrusion. Sheet-bar and tube-blanks were produced by a re-extrusion process. Cold rolling of bar, rod, and sheet products was

accomplished with little difficulty. Tubeblanks were cold-finished by swaging and drawing. The alloy showed a pronounced tendency to gall during drawing through carbide dies. This and other processing problems were overcome, and high-quality tubing was produced in the desired quantities. Additional evaluation of the alloy included annealing and other heat-treatment studies and pertinent, room-temperature, mechanical-property tests. Industrial participation in the program has been encouraged, and early results are reported. Author

N65-26599*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND OVERALL PERFORMANCE OF A TWO-STAGE AXIAL-FLOW PUMP WITH A TANDEM-ROW INLET STAGE
Donald M. Sandercock and James E. Crouse Jun. 1965 32 p refs
(NASA-TN-D-2879) CFSTI: HC $2.00/MF $0.50 CSCL 13K

The inlet stage group for a hign suction specific speed, multistage axial-flow pump was designed and tested in water. Inlet flow vector diagrams were optimized for suction specific speed at a suction specific speed of 30000. The first stage had a tandem arrangement of a cambered, tapered inducer and a transition rotor that adds enough head to keep the following highly loaded stages free of cavitation at design flow. The first-stage stator set up flow conditions suitable for the highly loaded rotor. Under noncavitating conditions, the pump performance at design flow was below the anticipated head and efficiency because the transition and second-stage rotors failed to achieve anticipated energy addition and efficiency. As the flow coefficient was reduced below 0.9, the pump developed regions of reverse flow. The characteristic had little drop in head rise in the stall range. The off-design blade row characteristics showed major redistributions of work between rotors. At design flow and a suction specific speed of 27000 in water, the pump head rise had begun to fall from the noncavitating values. Author

N65-26638*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A TECHNIQUE FOR JOINING AND SEALING DISSIMILAR MATERIALS Technology Utilization Report
Washington, NASA, Jun. 1965 11 p
(NASA-SP-5016) CFSTI: HC $0.25/ MF $0.50 CSCL 13H

During cryogenic research at NASA's Lewis Research Center, a boltless attachment and sealing method was conceived and used. The method features configured male and female members with a third material in the resulting cavity. Under the NASA Technology Utilization Program, this fastening method has been studied for potential use in industrial products and processes. The study has revealed that the basic concept can provide the basis for a family of fastening and sealing methods. Representative areas of design use are presented and investigatory activity suggested. Author

N65-26652*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF A HEMISPHERICAL METAL DIAPHRAGM FOR SINGLE-CYCLE LIQUID-METAL POSITIVE EXPULSION SYSTEMS
Sol Gorland Washington, NASA, Jun. 1965 21 p refs
(NASA-TN-D-2884) CFSTI: HC $1.00/MF $0.50 CSCL 13K

This report presents experimental results pertaining to the design and development of a metallic expulsion diaphragm for single-cycle positive expulsion of high-temperature liquid in an agravity condition. The diaphragms were made from type 304 stainless steel having a wall thickness of 10 or 16 mils. Tests were conducted in a 22-inch-diameter transparent lucite sphere in order to observe the diaphragm during the expulsion cycle. For simplicity, water was used as the working fluid, both pressurant and expellant. Greater than 98 percent expulsion without failure was obtained only with a diaphragm configuration less than a complete hemisphere. A diaphragm with a 1/2-inch equatorial segment removed from a 22-inch-diameter hemisphere successfully expelled over 98 percent of the enclosed liquid. Diaphragms slightly larger than complete hemispheres could only obtain between 60 and 82 percent expulsion before failure. It appears that metallic diaphragms without a method of controlling random deformation cannot go through more than one complete expulsion cycle without failure.
Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-25599*# National Aeronautics and Space Administration, Washington, D. C.
LASERS AND MASERS: A CONTINUING BIBLIOGRAPHY, JANUARY 1962–FEBRUARY 1965
May 1965 283 p refs
(NASA-SP-7009) CFSTI: HC $2.50/MF $1.50 CSCL 20E

An annotated bibliography is presented which includes studies on the research and development of lasers and masers, their application to ranging and communications systems, astronomy and optics, and metalworking. Also included are studies on their physical and electronic properties, functions, and performance. R.N.A.

N65-25734# General Electric Co., Syracuse, N. Y. Heavy Military Electronics Dept.
AROMATIC ORGANIC LASER DEVELOPMENT Final Report, 1 Apr. 1963–31 Mar. 1965
D. L. Stockman [1965] 77 p refs
(Contract Nonr-4135(00); ARPA Order 306-62; Proj. Defender)
(AD-613295)

A theoretical analysis and experimental work is reported on the development of a laser to produce coherent stimulated emission in the blue-green region in a purely organic dopant and host system. The theoretical analysis indicates that short lived four-level fluorescent compounds are the most suitable materials for this purpose. A total of four fluorescent compounds were found with the appropriate spectroscopic characteristics. The principal experimental efforts have included the development of a suitable host material in which the absorbing and scattering losses are kept to a minimum and an optical pump system capable of efficiently producing several megawatts of absorbable peak power in a short time. An optically isotropic polymer was developed whose properties appear to be suitable as a host material for the fluorescent species. Two optical pumping systems were used: (1) a modified xenon lamp, and (2) an argon theta-pinch lamp. Both of these systems were used to pump the samples. Some gain was observed in a liquid containing perylene as the active compound. This gain was observed at 4710 Å and probably due to preoscillation "superradiance" Gain in the fluorescent compounds contained in the polymer rods was not observed. N.E.A.

N65-25782# Army Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate

EXPERIMENTAL STUDY OF NEODYMIUM DOPED GLASS LASER

Alexander J. Casella Feb. 1965 58 p refs

(R-1748; AD-612885)

The effect of doping level and diameter of neodymium glass rods and reflectivity of the output mirror on the threshold energy and output energy of the laser and discussed. Data are presented on the energy output of glass rods having diameters of 0.25 in., 0.393 in., and 0.5 in. and doping levels of 1, 3, and 6% neodymium. In most cases, an output mirror reflectivity of 62% gave the highest energy output. Maximum output was obtained with the 1% doping, 0.5 in. diameter rod, using a 62% reflecting mirror. Due to pitting of the rods, the data were generally inconsistent and nonreproducible. Author

N65-25851# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.

DEVELOPMENT OF MILLIMETER AND SUBMILLIMETER MASER DEVICES Interim Technical Report No. 6, 1 Nov. 1964–28 Feb. 1965

W. E. Hughes, C. R. Kremenek, and W. E. Richards [1965] 44 p refs

(Contract AF 33(657)-10472)

(Rept.-490F; AD-612469)

During this reporting period, the major effort has been directed toward the operation of masers in the absence of an applied external magnetic field. The effort has been divided into two specific areas; i.e., 9.3 gc and 81 gc. Zero field masers have been successfully operated in both areas and the description of their operation comprises the bulk of this report. Each maser is described in detail and the conclusions drawn from experiments are given. Author

N65-25893# ITT Industrial Labs., Fort Wayne, Ind.

IMPROVED QUANTUM EFFICIENCY LASER DETECTORS Interim Engineering Report

E. H. Eberhardt and J. L. Gumnick 8 Mar. 1965 39 p

(Contract AF 33(615)-1596)

(AD-612682)

Results of an analytical study on the influence of varying the angle of incidence of injected light on photoemissive yield, and the effects of thickness on photoelectric yield, are reported. Also reported are results of experimental studies on the effects of thickness, angle, and substrate on quantum efficiency and the red response of photocathodes. Presented are modified expressions for relating curve shapes to absolute yields for photocathodes, which demonstrate that sharper peaks will be associated with higher yields. Data on continued efforts to eliminate inherent problems associated with the calibration and testing of electron multiplier and electron pulse counting equipment, are included. In view of the limited capabilities of photocathodes, the development of an overall detector quantum efficiency is proposed as a corrected measure of detector capability. Discussed are suggestions for a new definition of quantum efficiency (QE), a method of measurement of such an effective QE, and its significance. S.C.W.

N65-25936# Technical Research Group, Inc., Melville, N. Y.

IMPEDANCE MODEL OF FABRY-PEROT RESONATORS Scientific Report No. 6

S. R. Barone and M. C. Newstein Feb. 1965 34 p refs

(Contract AF 19(604)-8817)

(AFCRL-65-210; AD-614642)

Mode characteristics of a general class of open interferometers (Fabry–Perot resonators with flat mirrors of arbitrary aperture shape separated by the distance L) can be determined in the high frequency limit by the solution of a two-dimensional problem of a scalar field defined in the plane of a mirror, satisfying the helmholtz equation $[\nabla^2 + (2k/iL)\,D]\,f = 0$, and the impedance boundary condition at the edge of the mirror $f'/f = i(3k/e^{-i\pi/2}L)^{1/2}$. The eigenvalues D are simply related to the complex resonant frequencies from which one obtains the diffraction losses and phase shifts. The derivation of an impedance problem is a generalization of a similar result previously obtained for the special case of parallel strip interferometers. Author

N65-25966# General Electric Co., Syracuse, N. Y. Electronics Lab.

AROMATIC ORGANIC LASER DEVELOPMENT Quarterly Report

David L. Stockman [1965] 5 p

(Contract Nonr-4135(00); ARPA Order 306-62)

(QR-7; AD-612932)

Progress towards the development of a laser employing fluorescent organic compounds is reported. A continuum peaking in the range of 3500 to 4000 Å was observed in the argon-theta-pinch lamp spectral measurements. The irradiance of the lamp continuum at its peak corresponds in brightness to about 8000° to 10000° K blackbody. If the continuum were due to blackbody radiation, an 8000° K source would peak at 3650 Å and a 10000° K source at 2900 Å. Thus, it is not a clear cut case that the continuum is due to black-body radiation. Bremsstrahlung and recombination radiation are obvious possibilities. Also, on top of the continuum were a multitude of very narrow, very intense lines corresponding to atomic argon and to at least the first two ionized states of argon. The maximum output of the lines and the continuum was between 3000 Å and 4500 Å, making the lamp quite suitable for pumping perylene. A rough estimate of the radiating efficiency was that 1% to 10% of the electrical power is radiated as continuum between 2700 Å and 5700 Å. E.E.B.

N65-25986# Perkin-Elmer Corp., Norwalk, Conn.

TUNABLE COHERENT LIGHT SOURCE Quarterly Progress Report No. 3, 1 Nov. 1964–31 Jan. 1965

N. I. Adams [1965] 21 p refs

(Contract Nonr-4572(00))

(PE-TR-7946; AD-613080)

A modified marginal oscillator system containing a laser operating at 6328 Å and an RF voltage negative feedback loop was used to make a set of measurements. A change of gain of 1×10^{-6} at 10 kcps with a signal to noise voltage ratio of 3/1 to 4/1 at 10 kcps modulation frequency with one second integration time was observed. Numerical calculations on coherence length properties of lithium meta niobate showed a 10 times larger nonlinear optical coefficient than potassium dihydrogen phosphate material. G.G.

N65-25989# Perkin-Elmer Corp., Norwalk, Conn.

TUNABLE COHERENT LIGHT SOURCE Quarterly Progress Report No. 2, 1 Aug.–31 Oct. 1964

N. I. Adams [1964] 27 p refs

(Contract Nonr-4572(00))

(PE-TR-7863; AD-613063)

Research was continued on the development of a tunable coherent light source. The overall research program is reviewed and includes a discussion of initial objectives; the choice of experimental materials, methods, instruments, and other details; present status of the program, detailed choices expected to arise, and current objectives. Several calibrators were constructed and evaluated for use in measuring small changes in

the power level of a 6328 Å marginal oscillator. A Kerr effect, a Pockels effect, and an acousto-optical calibrator were investigated with the latter being chosen. R.N.A.

N65-26015# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
FEASIBILITY STUDY OF A LASER FLOWMETER FOR LOCAL VELOCITY MEASUREMENTS IN GAS FLOW FIELDS
J. W. Foreman, Jr., E. W. George, and R. D. Lewis May 1965 24 p refs
(R-149)

The Doppler shift in laser light scattered from smoke particles in a moving gas has been detected by optical heterodyne techniques, thereby verifying the feasibility of a laser Doppler flowmeter for measurement of local velocities in contaminated gas flow fields. Author

N65-26051# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
FLUORESCENCE PUMPING OF LASERS: EXPERIMENTS WITH COAXIAL XENON FLASH TUBE Technical Progress Report No. 376, Nov. 1963–Jul. 1964
Josef Jenscheck and Julian Thompson Sep. 1964 20 p ref
(NOTS-TP-3643; AD-447885)

This is the second in a series of reports on laser techniques and applications. In the first (TPR 356, NOTS TP 3506) preliminary and basic investigations in fluorescence pumping of lasers using ultraviolet excitation are discussed. In this publication, experiments in pump light modification by diffusely reflecting phosphor surfaces in the pump cavity using an actual coaxial xenon flash tube and measuring the fluorescent output from a ruby laser rod are reported. Results show that the amount of ultraviolet available in the xenon spectrum is not sufficient to warrant the use of phosphor reflectors with this source. Improvement of optical coupling between flash tube and rod was effected by filling the space between tube and rod with water in direct contact with the rod. This arrangement produces a nearly 100% increase in the fluorescent output of the rod. Studies, in which mercury flash or other high ultraviolet output source will be used for excitation, are continuing. Author

N65-26127# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
RAYLEIGH SCATTERING OF COHERENT LIGHT BY GASES
H. J. Watson, R. R. Mitchell, and J. R. Thornton Feb. 1965 40 p refs
(R-135)

This experiment is designed to study Rayleigh scattering using laser light (6943Å) and to determine if the laser can be used as a diagnostic tool to determine scattering center density. The scattered light intensity from argon, oxygen, nitrogen and air has been observed. The angular dependence of scattered light intensity for different polarizations of the incident laser beam has been observed for argon gas, and a linear relationship between scattered intensity and pressure exists for all gases studied. The relative differential scattering cross sections for argon, nitrogen and oxygen has been determined and compared with different theoretical predictions. The combined results indicate that it is possible to determine densities within reasonable accuracy between one atmosphere and ten microns under the conditions of this experimental arrangement. The problems of observations and the limitation of this technique are discussed. Author

N65-26625# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOME LASER-SYSTEMS CONSIDERATIONS
G. M. Kerbyson 24 Jan. 1963 28 p
(LMSC-704217)

The characteristics and limitations of lasers for applications in military and space systems are discussed. The state of the art and projections of future developments in lasers systems are also considered, and the feasibility of, and problem areas for, several general laser systems are indicated. Various types of lasers discussed include crystal, glass, gas, liquid, semiconductor, and quasi lasers. Transmission medium; pointing and tracking requirements; power, weight, and volume requirements; and information transmission are reviewed with respect to systems applications. Other laser topics discussed are laser noise, optical-radar, beam guidance, illumination, weapons, undersea, communications, attitude control, power–energy transmission, and data conversion applications. L.S.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-25591*# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Twenty-First Quarterly Progress Report, Apr. 1–Jun. 30, 1965
A. Gilbert and M. J. Klein 30 Jun. 1965 8 p refs
(Contract NASw-101)
(NASA-CR-63249) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The aging curve for the chromium wire, represented by the decreasing height of the internal-friction peak with increased aging time, is presented. Bend-test results for quenched and for quenched and aged chromium wire are tabulated. It was found that the transition from ductile to brittle behavior was extremely sharp, in that a specimen either failed in a completely brittle manner or bent to the maximum extent permitted by the jig. The lowest temperature at which an aged specimen was ductile was 74° C below the lowest temperature at which a quenched specimen was ductile, and the highest temperature at which a quenched specimen was brittle was 97° C below the equivalent temperature for the aged material. Thus, regardless of how the ductile-to-brittle transition is defined, the quenched material has a transition temperature between 74° and 98° C below that for aged material. Ductile specimens exhibited yield drops on the load-time curve which were more pronounced than for aged specimens. N.E.A.

N65-25594*# Bausch and Lomb, Inc., Rochester, N. Y.
GRATING GROOVE FORMATION IN Au AND Au–Ge ALLOYS Quarterly Report No. 4
C. Frank Mooney 31 Jan. 1965 91 p refs
(Contract Nonr-4277(00) (X))
(NASA-CR-63264) CFSTI: HC $4.00/MF $0.75 CSCL 11F

Electronmicrograph pictures and spectroscopic data of some of the gold film test gratings are presented. All work was done with carbon films from aluminum replicas to get better

details. Groove surfaces of an Au–Ge film appeared to be much less smooth submicroscopically than typical Au grooves, and the test ruling of various vaporization deposited Au films showed variations in deposits with differences in deposition details. Also included is a standard reflectance curve that was used to minimize the effect of the spectral variation of gold optical constants; its purpose is described. Two gold monitor films, one deposited on a poorly shined, and the other on a highly polished surface, reflected under 0.1% for the first, and over 1% for the second case. Some electron micrographs of thin, average, and thick chromium deposits on glass, and several surface pictures of gold films using dark-field illumination are included. G.G.

N65-25616# Joint Publications Research Service, Washington, D. C.
INFLUENCE OF ALLOYING ON SOFTENING OF CHROMIUM–NICKEL AUSTENITE
8 Jun. 1965 19 p refs Transl. into ENGLISH from Russian periodicals
(JPRS-30501; TT-65-31212) CFSTI: $1.00

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2. INFLUENCE OF TITANIUM, NIOBIUM, SILICON AND ALUMINUM ON THE SOFTENING OF CHROMIUM–NICKEL AUSTENITE V. K. Farafonov, M. M. Shteynberg, and V. N. Olesov p 11–17 refs (See N65-25618 15-17)

N65-25617 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF ALLOYING ON THE SOFTENING AND HEAT RESISTANCE OF CHROMIUM–NICKEL AUSTENITE
M. M. Shteynberg, V. K. Farafonov, E. G. Tret'yakova, and D. A. Mirzoyev *In its* Influence of Alloying on Softening of Chromium–Nickel Austenite 8 Jun. 1965 p 1–10 refs Transl. into ENGLISH from Fiz. Metal. i. Metalloved. (Sverdlovsk), v. 19, no. 3, Mar. 1965 p 411–417 (See N65-25616 15-17) CFSTI: $1.00

An experimental study of the influence of alloying on softening and heat resistance was carried out on a chromium–nickel austenite containing 14.5% to 15.5% chromium, 12.5% to 13% nickel, and 0.07% to 0.08% carbon. This austenite was formulated in such a way that when it was alloyed with molybdenum, tungsten, vanadium, titanium, niobium, silicon, and aluminum in quantitites (up to) 3.5%, the hardened alloy retained a purely austenitic structure. The alloys were formed in a high-frequency furnace, homogenized at 1150° C, and cast into ingots. Various tests on the alloys show good qualitative agreement between the influence of the alloying constituents on the softening and thermal recrystallization threshold of the austenite (on the one hand), and their effect on its ultimate strength and creep on the other. J.M.D.

N65-25618 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF TITANIUM, NIOBIUM, SILICON AND ALUMINUM ON THE SOFTENING OF CHROMIUM–NICKEL AUSTENITE
V. K. Farafonov, M. M. Shteynberg, and V. N. Olesov *In its* Influence of Alloying on Softening of Chromium–Nickel Austenite 8 Jun. 1965 p 11–17 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavednii, Chern. Met. (Moscow), no. 4, Apr. 1965 p 164–168 (See N65-25616 15-17) CFSTI: $1.00

In studying the influence of alloying elements on the softening process in chromium–nickel austenite, the alloying constituents were niobium, titanium, silicon, and aluminum. The alloys were melted down in a high-frequency furnace. Titanium and niobium were found to inhibit the softening of the austenite, to raise its lowest recrystallization temperature, to elevate the activation energy of the recrystallization process, and to retard grain growth at high temperatures. Silicon and aluminum, however, did not demonstrate any appreciable effects. Data suggest that the interatomic binding energy in the small gamma-lattice does not change to any practical extent when the austenite is alloyed with aluminum and silicon; the presence of carbon in the alloy precluded any decision about interatomic binding energy with respect to titanium and niobium. J.M.D.

N65-25685# Stanford Univ., Calif. Dept. of Material Science
INFLUENCE OF A FINELY DISPERSED SECOND PHASE ON RECRYSTALLIZATION Technical Report No. 15
J. L. Brimhall, M. J. Klein, and R. A. Huggins Feb. 1965 36 p refs
(Contract Nonr-225(34))
(SU-DMS-65-11; AD-613970)

The annealing behavior of internally oxidized alloys of silver containing magnesium and copper containing aluminum was studied by transmission electron microscopy. As with observations on pure materials, annealing of the dispersion-hardened alloys involves the formation of subgrains from the cell structure and the subsequent growth of the subgrains into the matrix. The kinetics of both subgrain formation and growth are extremely slow in the dispersion-containing alloys, compared to that with pure silver and copper. This retardation could be attributed to the nature of the deformed structure, which does not contain regions of severe plastic curvature. As a a result, the formation of mobile interfaces by misorientation accumulation is difficult. Particle interaction with dislocation motion during subgrain formation and direct particle interaction with the migrating subgrain boundaries during growth are discussed. Author

N65-25696# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A STUDY OF THE MASS EFFECT AND MICROSEGREGATION IN A HIGH-STRENGTH STEEL CASTING
Paul J. Ahearn and Francis C. Quigley Dec. 1964 23 p refs
(AMRA-TR-64-43; AD-613644) CFSTI: $0.50

Mass effect was studied in a unidirectionally solidified casting by determining mechanical properties vs distance into the casting. Dendritic variables, such as microsegregation and dendritic size, were measured as functions of distance. A cause and effect relationship was established between dendritic variables and mechanical properties. This relationship allowed the formulation of a homogenization treatment that resulted in ductilities of 50% reduction of area, at a tensile strength of 240 000 psi. Author

N65-25757# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy
AEROSPACE STRUCTURAL METALS HANDBOOK Quarterly Progress Report No. 3, 1 Jul.–1 Oct. 1964
J. G. Sessler and V. Weiss Wright-Patterson AFB, Ohio. AF Mater. Lab., Oct. 1964 13 p
(Contract AF 33(615)-1184)
(MET-E-1161-1064-QP3; AD-460992)

The program to revise, expand, and improve the *Aerospace Structural Metals Handbook* continues. First drafts of six new alloy chapters and four revision chapters are completed. The sample demonstration package of reference cards and data storage cards is 90% completed. Author

N65-25773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
STEELS FOR SOLID-PROPELLANT ROCKET-MOTOR CASES Technical Report, Jul.–Oct. 1964
I. Perlmutter and V. DePierre Jan. 1965 67 p refs
(AFML-TR-64-356; AD-612646)

On the basis of strength considerations, a comparison of rocket-motor case materials (titanium alloys, aluminum alloys, composite fiber glass and steels) shows that steel would result in the heaviest cases. However the current technology of steel places this material in a much more competitive position to meet the manufacturing technology required for large motor cases (above 120 in. diameter). Plane strain fracture toughness is used as a parameter of material reliability (performance according to design prediction). The relations between fracture toughness, yield strength, operational stress, and geometry of defects, and the use of these data in design are discussed. Three groups of steel (martensitic steels, low alloy martensites and maraging steels) are compared on the basis of fracture toughness-yield strength relation and weldability. The later two groups are the outstanding candidates for application to large cases where processing prior to welding is mandatory. The importance of future alloy steel development in the direction of improved balance between fracture toughness and yield strength for higher reliability is emphasized. Author

N65-25776# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
REFRACTORY METALS—AN ASSESSMENT
Harris M. Burte, Thomas D. Cooper, and Jerome K. Elbaum Jan. 1965 43 p refs Presented at the Ann. Meeting of AIAA, Washington, D. C., 29 Jun.–2 Jul. 1964
(AFML-TR-64-334; AD-613023)

The refractory metals (columbium, molybdenum, tantalum, tungsten) and their alloys offer attractive potential as metallic materials for high temperature applications. Their general characteristics (e.g., high melting point, ductile–brittle transition, oxidation characteristics) are discussed in relation to a critical assessment of the feasibility of their use in current and future aerospace applications. Coatings for oxidation protection, fabrication, and joining, areas of technology limiting the use of these materials, require further efforts. The high temperature capability is being utilized improvements in strength, ductility, and coating characteristics may increase reliability and capability. Author

N65-25780# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
THE INFLUENCE OF SUBZERO ROLLING ON THE TENSILE PROPERTIES OF COMMERCIALLY PURE TITANIUM
Thomas S. De Sisto and Frank L. Carr Dec. 1964 18 p
(AMRA-TR-64-47; AD-612794)

Commercially pure titanium was rolled at room temperature and −105°, −240°, and −320° F for various amounts of reduction to 40 percent, and tension tests were performed from room temperature to −320° F. Increased strength with increased retained true strain at fracture was obtained by selected deformation-temperature cycles. Log-log plots of the flow data of the starting material showed two segments differing in slope, rather than one straight line as predicted by the power law. The strains at which the inflection occurred decreased with decreasing testing temperature, while increasing amounts of reduction and decreasing rolling temperatures moved these points of inflection to higher strains. The inflection points are attributed to a change in deformation mechanisms from slip to twinning. The slopes of the two segments also decreased with both increasing reductions and decreasing rolling temperature. Author

N65-25791# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Quarterly Report No. 10, 28 Oct. 1964–28 Jan. 1965
R. L. Ammon and A. M. Filippi 28 Feb. 1965 16 p refs
(Contract NOw-64-0394-d)
(WANL-PR-M-012; AD-613356)

Melting and fabrication of two 4-inch diameter, T-222 double arc melted ingots are described. Ingot breakdown by both side and upset forging was investigated and yielded essentially defect-free slabs suitable for rolling to sheet. The success of side forging, however, implied that large ingots could be fabricated to slab without requiring the cutting of relatively small lengths for upsetting. Side forging of large ingots would produce a slab shape requiring less trim conditioning in preparation for rolling to sheet than that required on an upset slab. Author

N65-25792# Westinghouse Electric Corp., Blairsville, Pa.
THE PRIMARY WORKING OF REFRACTORY METALS
D. R. Carnahan and V. De Pierre (AF Mater. Lab.) Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 133 p refs
(Contract AF 33(616)-8325)
(AFML-TR-64-387; AD-612487)

Three-inch diameter billets of sintered W+2%ThO_2 and cast tungsten, molybdenum and columbium alloys were heated to 2400° to 4000° F and extruded by a 700-ton instrumented press through 60°, 90° and 120° dies into 1.15 in. to 1.75 in. diameter bars. Extrusion techniques were evaluated by correlating deformation loads and extrusion properties with processing variables. Die load data were evaluated by the relation, die load divided by cross-sectional area of the upset billet equals an extrusion factor, multiplied by the natural logarithm of the reduction ratio. Deformation loads varied with billet material compositions and characteristics. Chromium, columbium, molybdenum, tungsten and tantalum metals were extruded to provide wrought material of experimental alloys. Author

N65-25831# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
THE METALLOGRAPHY OF PYROLITIC GRAPHITE
Aram Tarpinian Dec. 1964 16 p refs
(AMRA-TR-64-41; AD-613643) CFSTI: $0.50

Etching of pyrolytic graphite by both argon ion bombardment and mercury ion bombardment is described. The difference between the microstructures revealed by the two methods is discussed, and an interpretation is suggested. Argon ion bombardment creates a leaf-like pattern reminiscent of stacked shingles. Mercury ion bombardment reveals a laminar structure unlike that produced by argon ion bombardment. Electrochemical polishing and etching reveals microstructures similar to those created by ion bombardment. Using an electrolyte based on phosphoric acid, microstructures similar to those resulting from mercury ion bombardment are revealed. Replacing the phosphoric acid with nitric acid results in microstructures similar to those obtained by argon ion bombardment. Based

on the correlation between microstructures developed by ion bombardment and electrochemical etching, it is concluded that the microstructures revealed represent the true structure. Author

N65-25835# Technische Hochschule in Wien (Austria). Inst. für Angewandte Physik

INVESTIGATIONS OF THE SYSTEMS Y-Mn, Gd-Mn AND Sm-Mn

F. Lihl 31 Jan. 1964 40 p refs

(Contract AF 61(052)-609)

(SR-7; AD-614462)

The mechanism of alloy formation by the amalgam process has been studied in some detail. It is very likely that at low temperatures manganese metal is formed from the RE-Mn amalgams. This manganese metal is coexistent with the compounds $REHg_2$ and REHg. At higher temperatures (700–800° C) RE-metal is formed from the RE-Hg compounds. The two intimately mixed, fine powdered metals react, yielding the RE-Mn-compounds. The systems Y-Mn, Gd-Mn and Sm-Mn have been studied in detail. The compounds YMn_2, $GdMn_2$, $SmMn_2$, YMn_4, $SmMn_4$, $GdMn_4$ and YMn_{12} have been prepared. Their lattice spacings have been evaluated. The structure of the compounds $REMn_4$ must be studied more in detail. The compound YMn_{12}, which forms peritectically, has been got either by melting the alloys, resulting from the amalgam process, or by sintering these alloys. By sintering only mixtures of the metals Y and Mn (without using an amalgam), this compound can not be prepared under the same conditions (temperature, tempering time). The amalgam process is therefore very advantageous for preparing RE-Mn alloys and compounds at temperatures below the melting points of the components. The magnetic transition temperatures (Curie-points) of the ferromagnetic compounds $REMn_4$ have been established (YMn_4: 219° C; $GdMn_4$: 192° C; $SmMn_4$: 170° C). Author

N65-25837# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics

MECHANICAL PROPERTIES OF EVAPORATED GOLD FILMS

J. M. Blakely 20 Sep. 1963 41 p refs

(Contract ARPA SD-88)

(ARPA-3; AD-426075)

Tensile tests were performed on gold films, of thickness in the range 2000 to 50000 Å, deposited on rock salt substrates at temperatures from 40° to 200° C, having grain sizes varying from about 200 Å to single crystal. It was found that the grain size had little influence on the early stages of the stress–strain curve, which is characterized by a very high work hardening rate and small uniform strain before fracture. The extent of plastic deformation is greater in single crystal films than in those with a small crystal size. The results are discussed in terms of dislocations, and it is shown that surface defects in the film may exert an important influence on the strength of the films, which is less than would be expected for the fine grain films, and may account for the large amount of scatter in the results. Author

N65-25842# Joint Publications Research Service, Washington, D. C.

STUDIES IN HEAT RESISTANCE OF CAST ALUMINUM ALLOYS

I. V. Kolobnev 18 Jun. 1965 182 p refs Transl. into ENGLISH from the book "Zharoprochnost' Liteynykh Alyuminiyevykh Splavov" Moscow, 1964 p 69–222

(JPRS-30678; TT-65-31290) CFSTI: $5.00

Cast aluminum alloys of systems containing silicon, magnesium, copper, nickel, manganese, titanium, chromium, and other elements, in a variety of combinations were studied for prolonged resistance at temperatures of 0.8° to 0.85° from their absolute melting point. It was concluded that a more heat resistant aluminum alloy should have the following properties: (1) A binary system with a eutectic of high melting point and a second phase that does not react with aluminum at high temperatures should serve as basis; (2) a melting point above 600° C; (3) a content of at least 35% eutectic and a narrow interval of crystallization; (4) transition group elements as basic alloying constituents; (5) grain boundaries of stable phases at working temperatures; and (6) small size and quantity of second phase particles. The most suitable systems are the Al–Ce, Al–C, and Al–Ni as the basis for an alloy for prolonged service at temperatures around 400° C. The alloy structure should be multiphase and particles of the second phases should reliably block the grain boundaries of the solid solution. G.G.

N65-25863# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.

DEVELOPMENT OF TOUGH, HIGH-STRENGTH ALPHA-BETA TITANIUM BASE ALLOYS

Arthur M. Ayvazian and Robert M. Colton Mar. 1965 14 p refs

(AMRA-TR-65-03; AD-613651)

The addition of varying weight percentages of the substitutional elements Cr, Mo, Nm, Ni, U, and Zr and the interstitial elements O, N, C, and B to the basic alloy, Ti-6Al-6V-2Sn-1/2Fe-1/4Cu, resulted in alloys which exhibited mechanical properties superior to those of the basic alloy. The optimum mechanical properties ranged from 198000 psi yield strength at 0.1 percent offset, 205000 psi tensile strength, 5% elongation, 14.0% reduction of area, and 5.4 ft-lb Charpy V-notch impact energy at −40 F for alloy Ti-6Al-6V-2Sn-1/2Fe-1/4Cu; to 221000 psi yield strength at 0.1% offset, 224000 psi tensile strength, 11.9% elongation, 32.1% reduction of area, and 5.9 ft-lb Charpy V-notch impact energy at −40 F for alloy Ti-6Al-6V-2Sn-3/4Cu-3Zr-0.015N-0.114 O_2-0.00217H-0.12C. Author

N65-25874*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Equipment Labs.

DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM Third Quarterly Report, 1 Jan.–1 Apr. 1965

C. R. Honeycutt, T. F. Martin, and J. C. Sawyer 19 Apr. 1965 20 p

(Contract NAS3-6010)

(NASA-CR-54389) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Three of the four vacuum fatigue test chambers are undergoing proof tests. The drive train has been designed and operated in air at room temperature and in vacuum at 2000° F. The transmission of the high frequency vibration through the vacuum chamber wall has been accomplished with no significant problem by mounting a stepped horn to a Curvic flange at the nodal point. Based on the measurement of deflection in the terminating horns, strains of approximately 2×10^{-3} in/in have been developed in the test specimens; however, fractures have been generally initiated in very short times in the mounting threads. Variations in specimen design are being studied to alleviate this problem. Author

N65-25886# Du Pont de Nemours (E. I.) and Co., Baltimore, Md.

THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY SHEET Technical Documentary Report, 15 Sep. 1962–31 Oct. 1963

James S. Clark, Albert L. Mincher, and George N. Villee Wright-Patterson AFB, Ohio, Res. and Technol. Div. [1963] 63 p ref

(Contract AF 33(600)-39942)

(RTD-TDR-63-4236; AD-427333)

This technical documentary report describes the development of a manufacturing process for D 43 columbium alloy sheet (Cb 10W 1Zr-0.1C, formerly called X-110). Six thousand pounds of second-melt electrodes were melted into eight-inch diameter ingots. The ingots were converted by extrusion and rolling to twenty-four inch wide sheets in three gages, 0.012", 0.018", and 0.030". The material was dispersion-strengthened by solution treatment at penultimate gage and aging at final gage. Sheets of all three gages had consistently high tensile strength at elevated temperature. The sheet processing is described. Sheet quality was emphasized. The gage control was excellent, the majority of sheets being within one-half of the standard tolerances. The results of the quality control inspection are given. Various mechanical and physical properties of final product sheet are also given. Author

N65-25897# Naval Ordnance Test Station, China Lake, Calif. Research Dept.

EFFECTS OF ULTRASOUND ON DEFORMATION CHARACTERISTICS OF STRUCTURAL METALS. PART 2: ACOUSTIC HEATING AND ZONE MELTING Technical Progress Report No. 371, 1 Jul. 1963–30 Jun. 1964

B. Langenecker, W. H. Frandsen, and A. Kennedy Feb. 1965 14 p refs

(NOTS-TP-3788, Pt. 2; AD-612915)

High-intensity ultrasound at 20 kc/sec is used in studies of mechanisms of metal deformation and treatment. Quantitative details are provided in the five parts of this report: (1) modes of intense ultrasonic stress waves in rods and bars, (2) conversion of acoustic energy into heat, (3) applications of ultrasound at high strain rate tensile tests, (4) measurements of internal friction during high-intensity ultrasonic radiation of metals, and (5) discussion of ultrasonic metal deformation with comparative data on the subject of ultrasonic metal forming processes. Author

N65-25902# Brown Univ., Providence, R. I. Div. of Applied Mathematics

IGNORING THE SINGULARITY IN APPROXIMATE INTEGRATION

Philip J. Davis and Philip Rabinowitz 20 Feb. 1965 27 p refs (Contract Nonr-562(36))

(AD-612476)

Computing machines have given prominence to a primitive method of obtaining the value of a singular integral. This method applies an ordinary rule of approximate integration and ignores the singularity. A study of the theoretical and numerical aspects of this method found it to be theoretically sound and to give good answers. There are also cases in which answers cannot be obtained, and borderline cases for which what value should be accepted as the answer. Author

N65-25906# Watervliet Arsenal, N. Y.

HYDROSTATIC PRESSURE INDUCED PLASTIC FLOW IN POLYCRYSTALLINE METALS

T. E. Davidson, J. C. Uy, and A. P. Lee Dec. 1964 16 p refs (WVT-TR-6431; AD-612881)

The effects of hydrostatic pressures to 26 kbars on the microstructure of polycrystalline Cd, Zn, Bi, Sn, Zr, Mg, Cu, and Fe were examined. Pressure induced microscopic plastic flow in the form of boundary migration, slip, multiple slip, or twinning have been observed either singly or in combination in Cd, Zn, Bi and Sn. No deformation was observed in Zr, Mg, Cu, and Fe. The occurrence of such deformation, in terms of its intensity and initiation pressure, relates directly to the degree of anisotropy in the linear compressibility. Pressure cycling does not significantly affect the residual tensile properties of a Zn alloy which exhibits pressure-induced deformation similar to that of pure Zn. Author

N65-25910# Naval Research Lab., Washington, D. C. Chemistry Div.

PROTECTIVE COATINGS FOR MAGNESIUM ALLOYS. PART I: EFFECT ON MECHANICAL PROPERTIES OF A NEW TECHNIQUE FOR FUSING TEFLON TO MAGNESIUM AND ALUMINUM ALLOYS

D. L. Venezky, A. G. Sands, and E. B. Simmons, Jr. 9 Mar. 1965 16 p refs

(NRL-6209; AD-613361) CFSTI: $0.50

Changes in the tensile and tensile yield strengths after fusing teflon on magnesium alloy AZ31B-H24, and aluminum alloys 2024-T3, 5052-H32, and 6061-T6 have been studied. The new flame technique for fusing teflon caused less alteration of the mechanical properties than the frequently used 750° F oven method. Aluminum alloy 2024-T3 was affected less than the other alloys. The flame or concentrated source of heat is superior to the oven method of heating because the high temperatures used are such that a rapid fusion of the coating can be accomplished without heating the bulk metal to the fusion or decomposition temperature of the coating. The new technique appears applicable to other coatings and substrates, although the thermal conductivities and heat capacities of the substrate and coating must be considered when optimum flame-fusion conditions are sought. Author

N65-25918# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.

HOMOGENIZATION OF HIGH-STRENGTH STEEL AT 2500° F

Francis C. Quigley and Paul J. Ahearn Dec. 1964 16 p refs

(AMRA-TR-64-42; AD-614277) CFSTI: $1.00

Unidirectionally solidified high-strength steel was homogenized at 2500° F for extended periods of time. The mechanical properties resulting from such treatments were compared with the properties of the material heat treated in the standard way. The improved ductility associated with the 2500° F homogenization is attributed to a reduction in the extent of micro-segregation with increasing homogenization time. The increase in ductility is a function of time of homogenization and diffusion coefficient of segregated alloying elements over the square of the distance from the surface of the casting to the test location. Author

N65-25923# Stanford Univ., Calif.

ELASTIC PROPERTIES OF A TUNGSTEN–SILVER COMPOSITE ABOVE AND BELOW THE MELTING POINT OF SILVER

S. Umekawa (Tokyo Inst. of Technol.), R. Kotfila (Aerojet-General Corp.), and O. D. Sherby 15 Feb. 1965 14 p refs Sponsored in part by ONR

(SU-DMS-65-9; AD-613181)

The dynamic Young's modulus of a composite of tungsten containing 20 volume percent silver was evaluated up to 1020° C. In the temperature range 25° to 800° C, it was shown that the temperature dependence and the absolute value of the modulus are closely approximated by the upper bound theory of Hashin and Shtrikman. Above 800° C the modulus decreases much more rapidly than predicted by the theory. This rapid drop in modulus is believed to be associated with interphase boundary shearing between the tungsten and silver phases. A large discontinuity in modulus (over 10% change) is observed at the melting point of silver. Above the melting point of silver the moduli of the composite and the tungsten are almost equal and contain an equivalent percent of pores, suggesting there is no strengthening of tungsten from the presence of molten silver. Author

N65-25931# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch

THE FIRE HAZARD OF METALLIC BERYLLIUM

A. Fairbairn 1965 36 p refs

(AHSB-S-R-80)

This report relates to the fire which occurred in the extract ventilation filters of the Beryllium Pilot Plant, and the subsequent Inquiry which included comprehensive tests on the ignition of beryllium metal. Safety principles are given, the application of which will reduce the risk of occurrence of a beryllium metal fire. The main contents of this report were originally issued in 1962. Author

N65-25957# Technische Hochschule In Wien (Austria). Inst. für Angewandte Physik

X-RAY-, DTA- AND THERMO-MAGNETICAL ANALYSIS OF Y, Sm, Gd, Dy, Ho, Er-Mn-COMPOUNDS

F. Lihl 31 Jan. 1965 50 p refs

(Contract AF 61(052)-609)

(SR-11; AD-614466)

Firstly, in this report a summary of the phases is presented, which occur in the systems Gd, Sm, Dy, Ho, Er-Mn. It has been detected that in all these systems the phases $REMn_2$, $REMn_4$ (RE_6Mn_{23} or $REMn_6$) and $REMn_{12}$ exist (the compound $SmMn_{12}$ has, up to now, not been detected). In contrast to literature the phases $HoMn_2$ and $ErMn_2$ possess (at least at room temperature) the same structure ($MgCu_2$) as the other $REMn_2$ compounds. The lattice spacings of the compounds diminish continuously with atomic number. Therefore the size factor seems to be predominant. The structure of $REMn_x$ ($x = 3,83 - 5$) is not known yet, perhaps because a range of homogeneity may exist. By DTA the systems Gd-Mn and Dy-Mn have been studied and phase diagrams constructed. The X-ray investigations and X-ray fluorescence analysis agree with these diagrams. Magnetic measurements with Y, Sm, Dy, Ho and Er-Mn_x ($x = 3,83 - 5$) yielded accurate Curie-points. The saturation magnetization of YMn_5 and $SmMn_5$ is higher than the values of literature. By measurements of the paramagnetic properties of $SmMn_5$ and $HoMn_5$ above the Curie temperature the fact that these compounds are ferrimagnetic and not ferromagnetic could be established. Author

N65-25981# Technische Hochschule in Wien (Austria). Institüt für Angewandte Physik

THEORIES OF THE DIFFERENTIAL-THERMAL-RESP. MAGNETO-THERMAL-ANALYSIS. A DETAILED DESCRIPTION OF THE TWO APPARATUS AND OF FURTHER MEASUREMENTS ON RE-Mn ALLOYS

F. Lihl 31 Oct. 1964 75 p refs

(Contract AF 61(052)-609)

(SR-10; AD-614465)

Methods for the measurement of temperatures and heats of transformation are described. It is shown that exact measurements on small samples can only be performed if up to 18 independent variables are taken into consideration. A special theory is developed which allows the computation of heats of transformation from differential thermal curves. If the losses of heat by radiation are also taken into account, direct measurements of heats can be performed up to 1400° to 1600° K with an accuracy better than ±10%. Based on the theory developed, and apparatus for measurements of samples between 0.5 to 1 gram of high reactive rare-earth alloys was developed. Also, a magnetic balance is described which allows measurements on the rare earth alloys from 80° K to 1400° K. It was found that $GdMn_2$ becomes antiferromagnetic at 86° K. and that $GdMn_5$ is not ferromagnetic but ferrimagnetic at 465° K. Further, the number of Bohr-magnetons, derived from the measurements at high temperatures in the paramagnetic region, are compared with theory. E.E.B.

N65-25984# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.

A STUDY OF THE EFFECT OF HEAT TREATMENT ON THE MICROSTRUCTURE AND PROPERTIES OF SPRAYED MOLYBDENUM

David J. Sellers and Milton Levy Dec. 1964 20 p refs

(AMRA-TR-64-50; AD-614127)

The effect of sintering on the microstructure, mechanical and physical properties of free-standing, oxyacetylene and arc-plasma-sprayed molybdenum bodies was studied. Significant increases in tensile strength, modulus of elasticity, density, and purity of sprayed molybdenum were achieved by a hydrogen sinter. A microstructure similar to recrystallized molybdenum sheet was obtained. Author

N65-25985# Stanford Univ., Calif.

YOUNG'S MODULUS OF EUTECTIC ALLOY SYSTEMS WITH SPECIAL EMPHASIS ON THE SILVER-LEAD SYSTEM Technical Report No. 6

S. Umekawa (Tokyo Inst. of Tech., Japan) and O. D. Sherby 1 Mar. 1965 27 p refs

(SU-DMS-65-14; AD-613182)

The dynamic Young's modulus—composition relation in eutectic alloy systems, without terminal solid solubility, follows either a linear relation or a less than linear relation. Essentially linear relations are obtained for systems where the moduli differences between the two phases are small or when the microstructure of the alloy exhibits a strong fibered texture such as is obtained in a cold drawn material. Eutectic systems containing a random distribution of phases with large moduli differences between the phases exhibit less than linear relations between modulus and composition. The theory of Hashin and Shtrikman is in qualitative agreement with experimental data obtained in the Ag-Pb system. Quantitatively, the actual modulus values of the composite are higher than the predicted values. This discrepancy may be due to the presence of internal stresses at the Ag-Pb interface which factor is not taken into consideration in the Hashin-Shtrikman theory. Author

N65-25993# Technische Hochschule in Wien (Austria). Institüt für Angewandte Physik

A SINTER PROCESS, USING MERCURY AS AN "AUXILIARY COMPONENT" AS APPLIED TO RE-Mn SYSTEMS. DIFFERENTIAL-THERMAL- AND MAGNETO-THERMAL-ANALYSIS OF THE SYSTEM Gd–Mn (0–50 w.% Mn) A Summarizing Discussion

F. Lihl 31 Jul. 1964 63 p refs
(Contract AF 61(052)-609)
(SR-9; AD-614464)

The amalgam process is the main step in a very particular sinter process. The new alloying process uses mercury as an auxiliary component. This report describes particularly final investigations of the amalgam process and the results gained by investigating alloying powders by the process. A discussion of the phase diagram Gd–Mn (0 to 50 wt.%) is given in detail.
N.E.A.

N65-26040# Bureau of Mines, Albany, Oreg. Metallurgy Research Center
STAINLESS STEEL–GADOLINIUM ALLOYS
M. Copeland, W. Barstow, C. Armantrout, and H. Kato Sep. 1964 34 p refs
(Contract AT(11-1)-599)
(BM-RI-6636)

Phase relations of gadolinium alloyed, up to 40 weight-percent (wt pct), with AISI 304-type stainless steel were established. Body- and face-centered cubic iron-rich solid solution phases and several intermetallic gadolinium-containing compounds of variable composition that approximated the formulas Fe_9Gd, Ni_7Gd_2, Ni_3Gd, Fe_2Gd, NiGd, and $NiGd_3$ were identified. The intermetallic phases Fe_9Gd and Ni_7Gd_2 were noted to melt at about 1,080° C at about 0 to 2 wt pct gadolinium. The melting temperature of Fe_9Gd increased with increasing gadolinium content to a plateau at about 1,230° C and 30 wt pct gadolinium and the melting point of Ni_7Gd_2 decreased to a plateau at 900° C and 30 wt pct gadolinium where Ni_3Gd, NiGd, and Fe_2Gd coexist. Body-centered cubic iron solid solution was stable from 1 to 2 wt pct gadolinium to higher contents, 30 wt pct gadolinium or possibly more, and face-centered cubic iron up to 12 wt pct gadolinium below 1,200° C. The stability of these phases above 1,200° C was not resolved except for the melting points. A limited number of fabrication variables as well as mechanical and corrosion properties of alloys containing up to 5 wt pct gadolinium were studied. Equilibrating and forming operations were best conducted at about 940° to 1,080° C. Some variability in the yield and tensile strengths of alloys was noted; however, there was a continual decrease in ductility and impact resistance with increasing gadolinium contents. The resistance of gadolinium alloys to corrosion in water at 354° C was about the same as stainless steel.
Author

N65-26053# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Aeronautics Div.
CRYOGENIC DESIGN DATA ON MATERIALS SUBJECTED TO UNILATERAL AND MULTIAXIAL STRESS FIELDS Second Quarterly Progress Report, 15 May–15 Aug. 1964
S. W. Mc Claren [1964] 174 p
(Contract AF 33(615)-1329)
(Rept.-2-53420/4R-2142; AD-460958)

This is the second quarterly progress report for a research program to determine basic mechanical properties of several metallic sheet materials subjected to uniaxial and multiaxial stress fields in a cryogenic environment. The test results will be compared on a basis of state of stress and temperature versus mechanical properties with special consideration being given to the most applicable failure theory. This data will be generated, evaluated and presented in a manner suitable for use by designers of advanced weapon and space systems.
Author

N65-26058 # Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
REVIEW OF RECENT DEVELOPMENTS. TUNGSTEN AND TUNGSTEN-BASE ALLOYS
V. D. Barth 7 Aug. 1964 7 p refs
(AD-460866)

A synopsis of recent tungsten and tungsten base alloys development, is presented. Data is reported in the following areas: consolidation and fabrication, mechanical behavior, physical metallurgy, and oxidation. Among the research cited are included: the development and testing of a forging process for tungsten and tungsten alloys, and the fabrication of porous tungsten applicable to the production of sweat-cooled solid rocket nozzle throats; research on the strength of very fine needle-like tungsten crystals and the tensile properties of recrystallized, doped powder-metallurgy tungsten–3 percent rhenium rod; research on the activated sintering of tungsten powders which demonstrated that W–Cu–Ni alloys sinter by a solution–precipitation process, and on the kinetics of densification below the liquidus temperature and subsequent dispersed-phase particle growth in the liquid phase; and studies of the increased volatility of tungsten in hydrogen–water vapor mixtures.
S.C.W.

N65-26063# Battelle Memorial Inst., Columbus, Ohio.
FURTHER INVESTIGATION OF NOTCH SENSITIVITY OF REFRACTORY METALS Bimonthly Progress Report
C. W. Marschall, F. C. Holden, A. Gilbert, and B. A. Wilcox 20 Aug. 1964 20 p refs
(Contract AF 33(657)-10363)
(BMPR-2; AD-460899)

In Phase I, fracture-toughness studies are being made on coated Mo-TZM alloy and D43-Cb alloy in order to evaluate the effect of protective coatings on this material parameter. In Phase II, crack propagation in Mo sheet is being studied by applying a modified version of the Robertson crack-arrest test. The effect of tensile strain rate on the ductile-to-brittle transition is being evaluated (? range of 10^{-5} to 10^{1} sec^{-1}), and local strain measurements at the root of notched Mo are being made by using the Moiré technique.
Author

N65-26089# Brown Univ., Providence, R. I. Div. of Engineering
NON-LINEAR MECHANICAL BEHAVIOR OF 1100 ALUMINUM AT 300°F
T. T. Wang and E. T. Onat Mar. 1965 41 p refs
(Contract Nonr-562(20))
(TR-40; AD-461442)

In the first part of the paper, experimental results are reported on the strain response of 1100 aluminum at 300° F to time dependent uniaxial stress. The second part of the paper is concerned with the use of functionals in the description of the observed dependence of strain on the stress history.
Author

N65-26093# Watervliet Arsenal, N. Y. Benét Labs.
OXIDATION OF IRON: ALUMINUM ALLOYS IN THE TEMPERATURE RANGE 500–900°C
F. Saegusa and L. Lee Mar. 1965 33 p refs
(WVT-6509; AD-613004)

The oxidation of 1, 3, 5 weight percent aluminum-iron alloys in oxygen has been investigated at one atmospheric pressure over the temperature range 500°–900° C. The effect of temperature and alloy composition on the oxidation rate

was determined by the gravimetric method. The scales formed on the alloy surfaces were examined using the technique of metallography, electron diffraction and electron microprobe analyses. The rate of oxidation decreased with increasing aluminum content and decreasing temperature. The oxidation followed approximately the parabolic rate law at the initial period of reaction. Microscopic examination of the oxidized specimens revealed the existence of two and three layers after oxidation at 500 and 600° C, respectively. The inner layer contained a higher aluminum content. The oxidation at 700–900° C gave a non-adherent outer layer in grey color. In areas where the oxide had spalled off, an adherent oxide layer was exposed. Small nodules with whiskers were observed at randomly distributed positions. Electron diffraction analysis of the surface of the 5 percent Al-Fe alloy indicated that the oxidation products consisted of a mixture of oxides. Author

N65-26102# Stanford Univ., Calif. Dept. of Materials
SOME ASPECTS OF SOLUTE SEGREGATION TO STACKING FAULTS Technical Report No. 13
M. L. Rudee and R. A. Huggins Feb. 1965 32 p refs
(Contract Nonr-225(34))
(SU-DMS-65-7; AD-612087)

Although the possibility of segregation of substitutional atoms to stacking faults has been discussed by a number of authors, experimental confirmation is quite contradictory. To clarify this point, a series of isothermal annealing measurements of a substitutional FCC alloy was performed to investigate the existence and kinetics of segregation. During the first hour of room temperature annealing of filings of a Cu plus 22.8 atomic % Zn alloy, the width of stacking faults increases. This increase is produced by segregation to the faults. Subsequently, after annealing for about one day, a decrease in the width of the faults occurs. The origin of this decrease in width remains unknown. By correlation of the amount of faulting present and the electrical resistivity, the following observations about the resistivity of stacking faults in this system can be made: A. Prior to the drop in the width of the faults, the fault contributes about twenty per cent of the resistivity per unit length of dislocation ribbon. B. The specific resistivity of the fault is $1.1 \times 10^{-12}\ \eta$ ohm-cm^2 where η is the number of faults per unit distance. Author

N65-26138# Watervliet Arsenal, N. Y. Benét Labs.
STRESS-AGING: A NEW TREATMENT FOR ALLOYS. PART THREE: EFFECT ON STANDARD TENSILE PROPERTIES OF FOUR ULTRA-HIGH-STRENGTH STEELS
R. H. Harrington Feb. 1965 35 p refs
(WVT-6501; AD-612462)

Stress-Aging (a new treatment) effects considerable improvement in standard strength properties for four Ultra-High-Strength Steels, (4340 Air-Melted, 4340 Vacuum-Melted, 4335 Si-Modified and 300M), without effective concurrent losses of elongation, reduction of area, or relative toughness. Respectively, stress-aging results in the following increases in strength properties: (a) Proportional limit: 42,300; 37,300; 72,500; and 75,000 psi; (b) Elastic capacity: 48%, 36%, 100% and 90%; (c) 0.1% offset yield strength: 40,000; 35,000; 56,500; and 62,000 psi. These properties are in parallel with the direction of the externally applied elastic stress. It is conjectured that these increases in strength properties may be due to strain-induced (sub-micron) precipitation of nickel-silicides and increased carbides, reacting with dislocations. Author

N65-26204 Sulzer Brothers, Ltd., Winterthur (Switzerland).
MECHANISMS OF FRACTURE OF STEEL UNDER SUDDEN AND SUSTAINED STRESS
W. Felix *In its* Sulzer Tech. Rev., Vol. 44, No. 1, 1962 p 36–45 refs (See N65-26202 15-15)

The tendency of a steel to brittle fracture is often judged by the temperature at which the abrupt drop occurs in the notch impact strength values. While this temperature permits classification of the steels according to their susceptibility to brittle fracture, it does not give any very reliable indication of their behavior under sustained stress. In order to throw some light on this problem, the mechanism of fracture of notched or grooved specimens was investigated in tensile and bending tests at room temperature, the steels chosen showing wide discrepancies in the transition temperature of the notch impact strength. The results reveal certain connections between the transition temperature and the mechanism of fracture under sustained stress which enable some conclusions to be drawn with regard to the risk of brittle fracture in practical service. Author

N65-26206 Joint Publications Research Service, Washington, D. C.
ALL-UNION SCIENTIFIC CONFERENCE ON DIFFUSION IN METALS AND ALLOYS
V. M. Golikov, V. T. Borisov, and G. V. Shcherbedinskiy *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 1–7 Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 2, Feb. 1965 p 58–61 (See N65-26205 15-15) CFSTI: $3.00

A conference on problems of diffusion in metals and alloys is presented and includes methods of studying diffusion, theory of diffusion, diffusion along grain boundaries, crystal structure defects and inhomogeneous distribution of impurity atoms, role of diffusion in different processes, and determination of diffusion characteristics in specific metallic systems. R.N.A.

N65-26208 Joint Publications Research Service, Washington, D. C.
ALL-UNION SCIENTIFIC AND TECHNICAL CONFERENCE ON PROTECTING CHEMICAL EQUIPMENT FROM CORROSION
L. M. Kamionskiy *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 11–19 Transl. into ENGLISH from Zashchita Metal. (Moscow), v. 1, no. 2, Mar.–Apr. 1965 p 249–253 (See N65-26205 15-15) CFSTI: $3.00

A brief summary on the development of highly corrosive resistant steels, ceramic plates, cement and concrete linings, glass heat-resistant pipes, polymeric coating materials, and protective coatings made of liquid nairits is given, and their application to improve corrosion control in chemical production lines is discussed. G.G.

N65-26214 Joint Publications Research Service, Washington, D. C.
THIRD PLENUM OF THE CENTRAL ADMINISTRATION OF THE SCIENTIFIC AND TECHNICAL SOCIETY FOR NONFERROUS METALLURGY
Yu. T. Skornyakov *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 41–44 Transl. into ENGLISH from Tsvetn. Metally (Moscow), no. 2, Feb. 1965 p 93–94 (See N65-26205 15-15) CFSTI: $3.00

Production increases in nonferrous metals output through updating of fabrication processes by utilization of advanced

scientific and technological considerations are discussed. Some difficulties in introducing scientific research at enterprises, which lack the requisite conditions, are pointed out. G.G.

N65-26215 Joint Publications Research Service, Washington, D. C.
REPUBLIC CONFERENCE ON INTENSIFICATION OF NONFERROUS METALLURGY PROCESSES IN KAZAKH SSR
L. A. Al'smik *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 45–47 Transl. into ENGLISH from Tsvetn. Metally, (Moscow), no. 2, Feb. 1965 p 95 (See N65-26205 15-15) CFSTI: $3.00

The present state and prospects for the use of electrothermal processes in the production of lead, copper, and antimony, and the problems of processing lead, copper, and antimony concentrates by intensified electrolysis are discussed in brief form. Emphasis was placed on the intensification of metallurgical processes in nonferrous metallurgy. G.G.

N65-26216 Joint Publications Research Service, Washington, D. C.
COORDINATION CONFERENCE ON MECHANIZING FREE FORGING
Yu. N. Nikolenko *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 48–50 Transl. into ENGLISH from Kuznechno-shtampovochnoye Proizv. (Moscow), no. 2, Feb. 1965 p 46 (See N65-26205 15-15) CFSTI: $3.00

Coordination of scientific research on mechanization of free forging processes through the entire technological process is needed. The rational application of free forging processes should be defined, and the required means for mechanization of forging devices should be produced serially in specialized plants. G.G.

N65-26217 Joint Publications Research Service, Washington, D. C.
SECOND SCIENTIFIC AND TECHNICAL CONFERENCE ON HEATING
V. N. Glushkov *In its* Soviet Conf. on Met. Probl. 8 Jun. 1965 p 51–54 Transl. into ENGLISH from Kuznechno-shtampovochnoye Proizv. (Moscow), no. 2, Feb. 1965 p 47–48 (See N65-26205 15-15) CFSTI: $3.00

The technology of metal heating before forging and stamping was briefly discussed. Electric heating processes were found well developed, but improvement in flame heating processes for metals is needed. Recommended is: (1) an increase in furnace building plants, (2) more scientific research in the technology of heating, furnace design, and connected elements, and (3) more qualified personnel to maintain modern furnaces. G.G.

N65-26224# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
CLASSIFICATION OF DMIC REPORTS AND MEMORANDA BY MAJOR SUBJECT
E. E. Fletcher 15 Jan. 1964 47 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-185; AD-432283)

A guide covering reports through DMIC report 193 and memoranda through DMIC memorandum 183 is presented. The publication allows quick identification and easy location of specific technical data and information in the various reports and memoranda which have been prepared and distributed by the Defense Metals Information Center (DMIC), as well as by DMIC's forerunner, the Titanium Metallurgical Laboratory. The index can be used to determine which reports and memoranda deal, to a significant extent, with a selected subject. A section on how to use the index is included. E.E.B.

N65-26225# Joint Publications Research Service, Washington, D. C.
STUDIES ON RARE AND RARE-EARTH ELEMENTS IN ENGINEERING
11 Jun. 1965 19 p Transl. into ENGLISH of the publ. "Red'kiye i Redkozemel'nyye Elementy v Tekhnike" Kiev, 1964
(JPRS-30586; TT-65-31256) CFSTI: $1.00

CONTENTS:

1. RESULTS AND BASIC DIRECTIONS OF RESEARCH IN THE FIELD OF RARE AND RARE-EARTH ELEMENTS AT THE INSTITUTES OF THE DEPARTMENT OF PHYSICAL AND TECHNICAL PROBLEMS OF MATERIALS SCIENCE, ACADEMY OF SCIENCES, UKRAINIAN SSR. V. A. Obolonchi p 2–11 (See N65-26226 15-17)
2. RESULTS OF THE FIRST ALL-RUSSIAN CONFERENCE ON USE OF RARE ELEMENTS K. F. Klubnichkin p 12–16 (See N65-26227 15-17)

N65-26226 Joint Publications Research Service, Washington, D. C.
RESULTS AND BASIC DIRECTIONS OF RESEARCH IN THE FIELD OF RARE AND RARE-EARTH ELEMENTS AT THE INSTITUTES OF THE DEPARTMENT OF PHYSICAL AND TECHNICAL PROBLEMS OF MATERIALS SCIENCE, ACADEMY OF SCIENCES, UKRAINIAN SSR
V. A. Obolonchi *In its* Studies on Rare and Rare-Earth Elem. in Eng. 11 Jun. 1965 p 2–11 (See N65-26225 15-17) CFSTI: $1.00

Research on the application of rare and rare-earth elements and studies of their properties encompassed electron-beam smelting of zirconium, vanadium, niobium, and other refractory rare metals; the introduction of cerium into cast iron for refining purposes; the use of zirconium in antisand pickup paints and molding mixtures to obtain castings with a clean surface; a method to obtain gallium nitride by the nitration of metallic gallium with ammonia; technical methods for producing LaS, CeS, PrS, and NdS; and a variety of other activities. G.G.

N65-26227 Joint Publications Research Service, Washington, D. C.
RESULTS OF THE FIRST ALL-RUSSIAN CONFERENCE ON USE OF RARE ELEMENTS
K. F. Klubnichkin *In its* Studies on Rare and Rare-Earth Elem. in Eng. 11 Jun. 1965 p 12–16 (See N65-26225 15-17) CFSTI: $1.00

Reports on the use of rare elements in metallurgy and machine building, in the fireproofing and silicate industry, as well as the direct industrial use of rare metal products were presented at this conference. It was established that additions of rare-earth elements increased the impact strength in a majority of construction steels. G.G.

N65-26274# Watervliet Arsenal, N. Y. Benet Labs.
THE BAUSCHINGER EFFECT IN A HIGH STRENGTH STEEL Final Report
Rex V. Milligan, William H. Koo, and Thomas E. Davidson Mar. 1965 38 p refs
(WVT-6508; AD-614115)

The object of this work was to quantitatively evaluate the Bauschinger Effect in a 4330 modified steel as a function of strength level and structure as derived from variations in heat treatment. Material having martensitic, pearlitic, and bainitic structures was studied utilizing a uniaxial tension-compression specimen. Various ways of defining the magnitude of the Bauschinger Effect are explained. One is a conventional approach as suggested by Welter, the other a technique which takes strain hardening into account. The results show the Bauschinger Effect to be independent of yield strength for three different strength levels of the martensitic material. It is only mildly influenced by material structure and independent of the direction of overstrain. The Bauschinger Effect increases with increasing permanent strain up to approximately 2% and thereafter remains essentially constant. Author

N65-26301# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
EFFECTS OF STRUCTURE ON THE PROPERTIES OF Ti-5Al-2.5Sn AND Ti-6Al-4V ALLOYS
R. A. Wood, D. J. Maykuth, and H. R. Ogden 20 May 1964 67 p refs
(AD-609353) CFSTI: $3.00

When tested under a variety of fabrication schedules and heat treatments, major differences in properties were not observed for different structures in the Ti-5Al-2.5Sn alloy. Tests on Ti-6Al-4V alloy, however, showed that properties are principally dependent on the ratio of the alpha and beta phases. For these alloys, notched and unnotched tensile and fatigue properties, creep, stress-rupture, and fracture-toughness properties are evaluated. J.M.D.

N65-26302# Syracuse Univ., N.Y. Metallurgical Research Labs.
CRACK INITIATION IN METALLIC MATERIALS Quarterly Progress Report
V. Weiss, G. Nash, and K. Schroder Oct. 1964 34 p
(Contract NOw-64-0275-d)
(QPR-3; AD-609739)

Crack initiation and propagation data for AISI 301 stainless, RS-120 (annealed), and PH-15-7Mo in the RH-1050 and the CH-900 conditions under alternating load is presented and analyzed using a new crack propagation law. The constants n^* and N_0, relating to crack propagation and initiation resistance which appear in this relation are evaluated for each material and specimen geometry. The constant n^* is found to be related to the strain hardening coefficient of the material and its values have been found to be a good indication of the material's susceptibility to crack re-initiation. The constant N_0 is found to correspond to the crack initiation times for sharp notch specimens but for the mold notch specimens, the meaning of N_0 on the material, the specimen geometry, and the applied stress level is obtained from the test data. Author

N65-26319# Dayton Univ., Ohio. Research Inst.
EVALUATION OF HIGH-TEMPERATURE MATERIALS Quarterly Progress Report, 1 Jul.–30 Sep. 1964
John C. Wurst, John A. Cherry, Dennis A. Gerdeman, and Norman L. Hecht 10 Oct. 1964 49 p refs
(Contract AF 33(615)-1312)
(QPR-3; AD-460906)

Refractory alloy coatings of molybdenum and columbium were evaluated to provide data on: oxidation resistance, coating effects on mechanical and physical properties of substrate alloys, and load-bearing capabilities. Metallographic analysis included visual examination of the substrate microstructure and microhardness measurements to see if side effects resulted from coating. Bend transition temperature and tensile tests were made to relate the effects of coating to mechanical properties at or near room temperature. Cyclic oxidation tests were made from 1600° to 3000° F, with a failure rate analysis at 2600° F. Structural capabilities were evaluated by creep-rupture tests in a full factorial experiment on two batches of coated columbium. Inconsistencies in the averaged data, found for both coatings, were mostly in the 2600° F tests at all stress levels, and the 7500 psi tests at the other temperatures, but these were the levels at which only two tests were performed. The other averages, based on eight tests, indicated the superiority of the Cr–Ti–Si coating to the Ag–Si–Al one with regard to creep-rupture life. M.W.R.

N65-26322# IIT Research Inst., Chicago, Ill.
PROTECTIVE COATINGS FOR TANTALUM-BASE ALLOYS Fifth Quarterly Report, 1 Jun.–31 Aug. 1964
V. L. Hill and J. J. Rausch [1964] 33 p
(Contract AF 33(657)-11258)
(IITRI-B6013-16; AD-461463)

Coating systems and techniques capable of providing reliable protection for tantalum-base alloys in an oxidizing environment at temperatures above 3500° F are being developed. Oxidation behavior, diffusion, and interaction experiments were performed on iridium and ruthenium base alloys and intermetallic compounds all containing hafnium and tantalum to establish their suitability and coating system concepts. Alloys in the Hf–Ta system were found to have good oxidation resistance at temperatures to at least 3800° F. Test results are tabulated. R.N.A.

N65-26323# Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering
EFFECT OF LONG-TIME EXPOSURE ON AM350 SHEET MATERIAL
T. M. Cullen and J. W. Freeman 1 Oct. 1964 9 p *Its* Rept.-04583-41-P
(Contract AF 33(616)-8334)
(PR-8; AD-461383)

Evaluated are tensile test and hardness data from cold rolled as well as annealed AM350 sheet material specimens after stressed or unstressed exposure of 2000, 5000, and 12,000 hrs at 550° F and at room temperature, together with data from accelerated exposure at 600°, 650°, and 700° F with subsequent tensile tests of these specimens. The strength properties of both the cold rolled and the annealed material did not change significantly as a result of stressed or unstressed exposure at 550° F for up to 12,000 hrs. A slight increase of strength was noted after this time, corresponding to two percent of the original strength of the alloy. Creep measurements during the first 22,000 hrs of exposure indicated that little strain occurred, and only contraction up to 0.03 percent was observed. It was concluded that no significant amount of creep had taken place in the alloy in either the cold rolled or the annealed state under the various exposures. G.G.

N65-26364# Rutgers Univ., New Brunswick, N. J. Materials Research Lab.
DUCTILE-BRITTLE TRANSITION IN REFRACTORY METALS Progress Report, Mar. 1–May 31, 1964
T. Ellis, L. F. Nanni, A. Shrier, S. Weissmann, G. E. Padawer et al 2 Jun. 1964 37 p refs
(Contract AF 33(657)-10872)
(PR-5; AD-461593)

An x-ray method is described which permits a precise determination of the interplanar spacings in a crystal. The method is capable of disclosing small differences in interplanar spacings even between various sets of (hkl) planes of the same form and, therefore, serves as a basis for a stress–strain analysis. An error analysis of this method has been carried out and it has been shown that the minimum measurable strains in the lattice, expressed as $\Delta d/d$, are a function of the diffraction angle θ. For θ varying from 35° to 65° the minimum measurable strains vary from 0.03% to 0.009%. A precision determination of the lattice parameter of a zone-refined tungsten crystal was also carried out and yielded a value for $a_o = 3.16566 \pm 0.00002$ Å.

Author

N65-26374# Midwest Research Inst., Kansas City, Mo.
RESEARCH ON THE MECHANISMS OF FATIGUE IN ULTRA-SMALL SPECIMENS Quarterly Progress Report, 1 Sep.–30 Nov. 1964
J. C. Grosskreutz 10 Dec. 1964 13 p refs
(Contract AF 33(657)-10883)
(QPR-5; AD-461384)

The sequence of events is described during fatigue of notched 1100-0 aluminum plate. Slip bands formed at the beginning on the notch surface deepen into fissures which eventually link up into a single dominant crack. Fifty to 70 percent of fatigue life is required for this crack to begin propagating along the face of the sample. Experiments on notched 2024-T4 plate have shown a much different nucleation sequence. A single small crack is first visible on the notch surface at optical magnification aftter about 10 percent of life. Seventy-five percent of life is required for this crack to leave the notch and begin propagating across the face of the sample. Both electron replicas and transmission photos were obtained from the fracture surfaces. Fracture occurs along subgrain boundaries and there is evidence for impurity segregation along the boundaries. Progress on the study of fatigue hardening mechanisms in copper is discussed.

Author

N65-26422*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy
ADHESION BETWEEN ATOMICALLY PURE METALLIC SURFACES, PART IV Semiannual Report
Douglas V. Keller, Jr. Mar. 1965 66 p refs
(Grant NsG-483)
(NASA-CR-63417; SURI-MET.1100-653SA) CFSTI: HC $3.00/MF $0.75 CSCL 11F

Considerable detail is given on existing literature and research efforts relating to the study of adhesion as applied to metallic systems. Sections are devoted to physical adhesion, chemical adhesion, and mechanical effects. A short review of experimental studies at the laboratory is included. A system was developed which will allow accurate, reversible contact force measurements between atomically clean and solid surfaces in a uh vacuum at a force level of accuracy of 1 part in 500 and a load level of 5 gm. In order to measure the forcs of adhesion for this system, which is reproducible in air and in vacuum, the current in the strain gage solenoid is reduced until the contact breaks. Another system, under development, is expected to shed some light on the nature of the physical adhesion forces between clean metallic surfaces.

M.W.R.

N65-26431# Gt. Brit. Ministry of Aviation, Mottingham. Technical Information and Library Services
CERTAIN CHARACTERISTICS OF SILICIDING OF METALS WHICH ARE DIFFICULT TO FUSE [O NEKOTORYKH OSOBENNOSTYAKH VAKUUMNOGO SILITSIROVANIYA TUGOPLAVKI METALLOV]
V. E. Ivanov, E. P. Nechiporenko, V. M. Krivoruchko, and A. S. Mitrfanov Apr. 1965 6 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 17, no. 6, 1964 p 862–865
(TIL/T5569)

When Mo, W, and Ta were placed in a vacuum of saturated silicon vapor at 1200° and 1250° C, the speed of silicide layer formation was determined by silicon diffusion, and the curves relating layer thickness to time were parabolas. In addition to the disilicides, $MoSi_2$, WSi_2, or $TaSi_2$, there were thin layers of the lower silicides, Mo_5Si_3, W_5Si_3, or Ta_5Si_3. Observations indicated that for Ta the lower compound is formed first, and that the presence of the thermally less stable higher silicide may result in the corrosion of Ta in air. In vacuum siliciding of metals which are difficult to fuse, the rate of growth is less than from the gaseous phase. When Mo wire was treated by the decomposition of $SiCl_4$ in a stream of H at 1200° to 1800° C, the rate of growth increased as the temperature of the sample increased. When siliciding took place under conditions of a temperature gradient between cell and sample, however, the rate of layer formation diminished as the temperature of the sample increased. Again, the dependence of layer thickness on time was parabolic.

M.W.R.

N65-26548# Battelle Memorial Inst., Columbus, Ohio.
THE FABRICATION OF BERYLLIUM
A. F. Gerds and F. W. Boulger Huntsville, Ala., Army Missile Command, 28 May 1965 129 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-227; AD-463727)

Current techniques for fabricating beryllium into components and hardware parts for aerospace requirements are summarized. Fabrication difficulties are enumerated along with methods for circumventing them. Extraction methods, alloys, properties, plastic deformation processes, powder metallurgy methods, machining, postfabrication treatments, joining methods, applications, and toxicity of beryllium are discussed.

R.N.A.

N65-26559# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF PHASE-REINFORCED HIGH-TEMPERATURE ALLOYS PRODUCED DIRECTLY FROM A MELT
F. D. Lemkey and M. J. Salkind 15 Apr. 1965 32 p refs
(Contract DA-19-020-AMC-00434(X))
(D910261-3; AMRA-CR-64-05/1; AD-463840)

The results of continued investigations on whisker-reinforced high temperature eutectic alloys are presented in this third quarterly report. Ingots of Ta-Ta_2C have been unidirectionally solidified at 15 cm/hr to produce a composite of aligned tantalum carbide rods and platelets within a matrix of tantalum using a modified electron beam zone melting apparatus. A consistent crystallographic relationship between Ni and NiBe interpenetrating single crystal lamellae of a eutectic grain has been examined in detail using a hard sphere atomistic model of the interface. The results of a study of cyclically loaded Ni-NiBe eutectic alloy has indicated that most of the deformation takes place within the nickel solid solution matrix. The yield strength increased with each cycle and reached a constant maximum value after four cycles.

Author

N65-26588# Bureau of Mines, Minneapolis, Minn. Metallurgy Research Center
EXPERIMENTAL PRODUCTION AND SMELTING OF PRE-REDUCED IRON ORE PELLETS

M. M. Fine, P. L. Woolf, and N. Bernstein 1964 33 p refs (BM-RI-6523)

Continuous experimentation utilizing a 3- by 36-foot rotary kiln was conducted to demonstrate the feasibility of simultaneous induration and reduction of magnetic taconite concentrate. Lignite, or lignite-anthracite mixtures, and green magnetite pellets (64.2 percent Fe, dry basis) were heated in a rotary kiln to about 2,100° F. After separation from excess reductant, the product pellets were found to be highly reduced and acceptably hard. A total of 140 tons of prereduced pellets with an average Fe content of 79.0 percent was produced at Minneapolis and smelted in the Bureau's experimental blast furnace at Bruceton, Pa. Two additional supplies of prereduced pellets were obtained from The Steel Company of Canada, Ltd., Hamilton, Ontario, which contained 83.8 and 91.3 percent Fe, respectively. Smelting of prereduced pellets was compared with that of unreduced pellets obtained from The Hilton Mines, Shawville, Quebec, and from the Erie Mining Co., Hoyt Lakes, Minn. Blast furnace tests established that a substantial decrease in coke rates and higher production result from the use of prereduced pellets. Author

N65-26610# Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT Summary Report, 1 Apr. 1964–1 May 1965
F. H. Simpson and L. M. Stejskal May 1965 101 p
(Contract NOw-64-0194-f)
(AD-464507)

The effects of particle geometry, forming methods, sintering, and metal-to-ceramic ratio on the strength, ductility, and oxidation resistance of a refractory laminate particle composite material were investigated. Knife coating methods were developed capable of producing laminates having metal and ceramic layer thicknesses of 20 to 25 microns. Small elongated particles had the highest flexural strength. Ductility increased with increasing laminate particle size. Oxidation resistance and ductility were more subject to variation due to impurities than to particle geometry. Flexural strength increased with metal content decrease while ductility increased with an increase in content. Compressive strength and oxidation resistance increased with increasing ceramic content. Isostatic pressing produced random laminae orientation with hot pressing producing the highest degree of orientation. Orientation of laminae parallel to the direction of tensile stress increased flexural strength. Differential shrinkage between metal and ceramic phases, heating rate, surface activity, and particle packing were found to be critical. R.N.A.

N65-26611# Honeywell, Inc., Hopkins, Minn. Research Center
THE MECHANICAL AND MICROMECHANICAL PROPERTIES OF BORON Final Report, 1 Jan.–31 Dec. 1964
J. A. Sartell and C. J. Speerschneider Jan. 1965 40 p refs
(Contract NOw-64-0159-f)
(AD-457072)

A characterization has been made of the room temperature mechanical and micromechanical behavior of bulk crystalline boron. Several methods of producing crystalline material of sufficient size for testing were evaluated, with a casting technique selected for use in this investigation. Properties of importance to mechanical behavior, such as the modulus of elasticity and coefficient of thermal expansion, were determined. Further, a study of the fracture mode has shown that structural features can influence the fracture path and provides the basis for future improvement of mechanical properties. The micromechanical behavior of bulk crystalline boron has shown a completely elastic response to stress at levels up to fracture. Future work will continue this characterization, with the emphasis on continued improvement in fabrication techniques and on elevated temperature studies of fracture character and microstrain behavior in order to determine the effects and importance of various parameters such as surface condition, structure, and prior history. Author

N65-26653*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
HIGH-TEMPERATURE CREEP BEHAVIOR OF A COLUMBIUM ALLOY, FS-85
Robert H. Titran and Robert W. Hall Washington, NASA, Jun. 1965 23 p refs
(NASA-TN-D-2885) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Creep tests of 1000 hours duration and greater were conducted in the temperature range 2000° to 2200° F on a commercially available columbium alloy (FS-85) in vacuum units designed and built to achieve ultimate pressures of 10^{-9} torr. At a stress level of 10000 pounds per square inch, FS-85 exhibited moderate creep resistance at 2000° F, 1-percent strain being achieved in 775 hours. At 2100° and 2200° F and the same stress level, the alloy was much weaker, 1-percent strain being achieved in 355 and 50 hours, respectively. The Manson-Haferd linear time-temperature parameter proved moderately successful in predicting the long-time creep lives from relatively short-time creep data, the maximum error between predicted and experimental lives being a factor of 1.7 and the average error being a factor of 1.3. The agreement is considered good in view of the large scatter generally observed in long-time high-temperature creep tests. In all cases, however, the observed experimental life was shorter than the predicted life. The nonconservative nature of these predictions may be due in part to the fact that the predictions were based on data obtained at a pressure level of approximately 10^{-6} to 10^{-7} torr, but the long-time tests to which the predictions are compared were made at a lower pressure level, 10^{-8} to 10^{-9} torr. Creep tests conducted in the conventional-vacuum units (10^{-6} torr) and the ultrahigh-vacuum units under the same conditions of temperature and stress yielded creep curves that are virtually identical for the first few hundred hours but that deviate with increasing test time. The conventional-vacuum tests then showed a reduced creep rate compared with that of the ultrahigh-vacuum tests. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-25749# Western Co. of North America, Dallas, Tex. Research Div.
INVESTIGATION FOR THE USE OF ADDITIVES FOR THE REDUCTION OF PRESSURE LOSSES Final Report
G. T. Pruitt and H. R. Crawford 30 Jan. 1965 68 p refs
(Contract DA-23-072-AMC-309(T))
(AD-613345)

When some friction reducing additives in MIL-H-5606A hydraulic fluid were studied, a friction reduction as high as 60% was obtained. Two percent (wt) of the additive selected for extensive testing increased the apparent viscosity by a factor of about two and the density by about 0.2%. The base fluid

was found to be slightly non-Newtonian (shear thinning) and the addition of the additive made the fluid more non-Newtonian. Velocity profile data, taken within 0.01 in. of the wall, showed that the viscous sublayer for the treated fluid is 3 to 10 times thicker than that for the base fluid. Profiles for the treated fluid are more laminar than those of the base fluid, that is, the intensity of turbulence is reduced by the addition of the additive. In some cases negative values of the pitot differential pressure were obtained very near the wall, which may be due to the development of elastic forces in the fluid. The additive can produce friction reduction in fairly viscous oils and should be tried in an Army hydraulic transmission system. Author

N65-25754# Texas Instruments, Inc., Dallas. Semiconductor Exploration Lab.
ORGANIC MATERIALS FOR ELECTRONIC APPLICATIONS Third Quarterly Progress Report, 18 Jul.–17 Oct. 1964
Rowland E. Johnson and R. C. Sangster [1964] 34 p refs
(Contract AF 33(615)-1364)
(TI-08-64-161; AD-460929)

Organic thin film polymers were found unsuitable as possible dielectric materials on the silicon adaptive logic elements. Evaluation of the polymers as capacitor dielectrics was extended to 2.5 Gc by measuring capacitance as a function of frequency. The polymers perform satisfactorily in capacitors, but fail when used in a thin film-integrated circuit hybrid because of the high processing temperatures required for other steps in the production. Organic polymer films were deposited as insulation over thin metal films used as magnetic memory planes. The polymer adhered well to the metal and appeared to be pinhole-free when tested with a mercury globule. Evaporated gold stripes showed a high frequency of shorts to the base metal. Log R vs 1/T and thermal activation energy (E_A) data were summarized for a series of metal organics. Polymercuriferrocene and polyaminoquinone (PAQ) polymers were evaluated. Author

N65-25762# Texas Instruments, Inc., Dallas. Semiconductor Exploration Lab.
ORGANIC MATERIALS FOR ELECTRONIC APPLICATIONS Second Quarterly Progress Report, 18 Apr.–17 Jul. 1964
Rowland E. Johnson and R. C. Sangster [1964] 19 p refs
(Contract AF 33(615)-1364)
(TI-08-64-112; AD-460928)

Organic polymer thin films have been prepared in the photoelectret configuration as the dielectric in a thin film field effect transistor. Because photomasking techniques using KMER attack the polymer, evaluation is not complete. The films do not induce a channel between the source and drain. No photoeffects are seen in the source-drain current if the organic film is illuminated. Preliminary investigations have been made to evaluate the organic polymer films as a capacitor dielectric and as a metal film insulator. Nickel squarate chelate polymers prepared at different temperatures have different polymer chain lengths and show different thermal activation energies of electrical conductivity. Chromium squarate polymer prepared in water solvent did not give measurable evaluation samples. Other solvents, such as dimethylformamide, are being evaluated for this polymer and nickel squarate. A number of other metal chelate polymers are being studied, including mercury and nickel chelates of 2,5 dichloro-3, 6 dihydroxy-1, 4 benzoquinone, mercuroferrocene, and the copper chelate of the polymer formed from chloranil and benzidine. Author

N65-25885# General Electric Co., Evendale, Ohio. Flight Propulsion Lab. Dept.
HIGH STRENGTH GLASS FIBERS DEVELOPMENT PROGRAM, TASK 2 Final Report
D. L. Hollinger, H. T. Plant, R. F. Mulvey, and T. J. Jordan
20 May 1963 50 p refs
(Contract NOw-61-0641-c(FBM))
(AD-405897) CFSTI: $1.25

The influence of moisture on the effective strength of E-glass fibers, both as single monofilaments and when incorporated with epoxy resin into filament-wound ring structures, has been investigated. Humidity in the atmosphere surrounding the fiber was controlled during various periods in its history. Split ring tensile tests on the composites showed a definite advantage for the maintenance of dry surroundings throughout all processing steps. Furthermore, these indicated that the greater significance in determining strength than mere exposure to moisture during other periods. Thus, a stress-activated corrosion reaction was suspected to be causing large strength losses during the actual testing. Work with single bare fibers of E-glass has served to verify the importance of this stress corrosive reaction. Author

N65-26002# Schjeldahl (G. T.) Co., Northfield, Minn.
LIGHTWEIGHT REINFORCED BALLOON MATERIAL INVESTIGATION Quarterly Report, Period Ending Dec. 31, 1964
John A. Mac Fadden 18 Feb. 1965 35 p
(Contract Nonr-4096(00))
(AD-612598)

Effort was redirected from constructing a polypropylene balloon to improving lightweight balloon construction using improved sealing and handling methods. The leakage of balloons constructed of 0.25 mil Mylar and scrim was determined to be caused by point blocking. This blocking resulted from adhesion of an adjacent layer of Mylar coming into contact with flocking agent which holds the scrim threads together. Antiblocking agents and modified adhesives were investigated with negative results. The only solution found was to laminate Mylar to both sides of the scrim but the resultant balloon was too heavy for its original mission. The ultimate solution to the problem of providing a lightweight, nonblocking balloon material appears to be to eliminate the flocking agent by laying adhesive-coated threads directly on light-gage Mylar and curing the resulting web while it is separated by a release material.
E.E.B.

N65-26013# Army Engineer Research and Development Labs., Fort Belvoir, Va. Scientific and Technical Information Branch
USE OF TRANSPARENT PLASTICS IN STEREOTOPOGRAPHIC WORK
M. A. Blyumin [1965] 6 p Transl. into ENGLISH from Geodez. i. Kartograf. (Warsaw), no. 7, 1964 p 49–52
(T-1769-65; AD-614106)

The use of transparent plastics for stereotopographic work and for map revision is briefly described for the following three methods: (1) direct engraving of an original in an engraving coating with separations for relief, contours, and hydrography; (2) engraving of the compiler's original without separation; and (3) production of a sketch original that serves as basis for engraving the publisher's original. Positive photoplans were made from contact copies of half-tone negatives on a gelatin light-sensitive layer deposited on plastic and found suitable for subsequent stereotopographic operations. The use of khostofan is advisable in the preparation of map originals of class 3 or 4 difficulties, and the more transparent astralon for regions of greater difficulties. G.G.

N65-26107# Forest Products Lab., Madison, Wis.
FATIGUE STRENGTH OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN "S" GLASS FIBERS
Kenneth H. Boller Wright-Patterson AFB, Ohio, AF Materials Lab., Dec. 1964 22 p refs Preprint
(Contract AF 33(657)63-358)
(AFML-TR-64-403)

Fatigue curves are presented for plastic laminates reinforced with layers of unwoven "S" glass filaments in a matrix of epoxy-type resin and subjected to various alternating stress amplitudes superimposed on constant mean loads of 0 and 25000 pounds per square inch tensile stress. The S-N curves were determined by axially loading specimens of three types of construction, namely: (1) all layers of unwoven glass parallel to the principal axis, (2) alternate layers at ±5° to the principal axis, and (3) alternate layers at 0° and 90° to the principal axis. All experiments were conducted on unnotched specimens, at 900 cycles per minute, in an atmosphere maintained at 73°F and 50 percent relative humidity. Loads were applied parallel to the principal axis. The S-N curves and replication of specimens establishing the curves show that the fatigue strength of "S" glass laminates is significantly greater than that of similar "E" glass laminates. Author

N65-26141# Naval Ordnance Lab., White Oak, Md.
GLASS FIBER SURFACE TREATMENTS: THEORIES AND NAVY RESEARCH
Porter W. Erickson Feb. 1964 27 p refs
(NOLTR-63-253; AD-426292) CFSTI: $0.75

This report reviews and discusses the current status of both old and new theories to explain the mechanism of finishes at the glass-resin interface in reinforced plastics. All the evidence for and against the Chemical Bonding Theory is cited and examined in view of the fact that this is still the only theory which predicts chemical finish structures which lead to improved laminate strengths. The two events in 1963 which should greatly speed up a solution to the interface problem are discussed. The first is the formation of the "Ad hoc Committee on the Interface Problem in Fibrous Composites" by the Materials Advisory Board. The second is the two-day Navy sponsored meeting on the interface at the Naval Research Laboratories. The expected impact of these events on accelerating fundamental approaches to bear on the problem is discussed. Both recent and current studies by Navy laboratories and contractors to the Navy which are concerned with the resin-glass bond and stronger reinforced plastics are cited and briefly reviewed. Author

N65-26147*# Dow Corning Corp., Hemlock, Mich. Research Dept.
STERILIZABLE OPTICAL COUPLING MATERIAL Final Report, 8 Jul. 1964–8 Mar. 1965
Jerry Helmer 8 Mar. 1965 42 p Prepared for JPL
(Contracts NAS7-100; JPL-950767)
(NASA-CR-63395) CFSTI: HC $2.00/MF $0.50 CSCL 11I

An optical coupling material was developed and tested as per J.P.L. contract number SW 3257. The material finally developed would withstand the optical and environmental tests required. Dow Corning® XR6-3488 Resin and Curing Agent with one-hour catalyst, were recommended as the optical coupling material. A bonding agent, Dow Corning® 92003, was found to be helpful in securing the resin to the glass surfaces. A procedure was established for preparing the resin and assembling the fixture in which the optical coupling material will function. An accelerated test, conservatively projected, indicates the sample will lose less than 1.7 percent weight in 1400 days at 25°C and a pressure of one millimeter of mercury. The probability of the sample functioning in the specified environments for periods of several months are therefore concluded excellent. Author

N65-26149*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group
DEVELOPMENT OF DIELECTRIC WINDOWS FOR SPACECRAFT ANTENNAS Final Report, 1 Jul. 1963–30 Jun. 1964
B. G. Kimmel [1964] 55 p refs
(Contract NAS8-11026)
(NASA-CR-63392; P64-70) CFSTI: HC $3.00/MF $0.50 CSCL 11I

Criteria were chosen for the selection of candidate dielectric window materials and seven types of reinforced plastics and two ceramics were chosen for the screening evaluation. The candidate materials were subjected to a series of screening tests, included the degree of vacuum stability, the effect of ultraviolet radiation on the solar absorptance and dielectric properties and the gas permeability. Methods of decreasing the gas permeability, including lamination with plastic films and resin impregnation, were investigated. The effect of thermal control coatings on the dielectric properties of a standard plastic radome material was investigated. Author

N65-26357# Federal Aviation Agency, Washington, D. C. Flight Standards Service
APPLICATION OF GLASS FIBER LAMINATES IN AIRCRAFT
1964 42 p refs
(AC-20-21) GPO: $0.35

Past and current uses of reinforced plastics in aircraft construction are discussed with emphasis on plastic laminates reinforced exclusively with glass fiber. Polyester resins are widely used in low-pressure reinforced plastics, epoxies for higher strength and greater chemical resistance plastics, phenolics for higher strength and greater heat resistance plastics, and silicone resins for their electrical properties and heat resistance. Numerous possible combinations of resins, catalysts, reinforcement, finishes, and molding processes can be employed to construct a large variety of materials of corresponding mechanical and physical properties. Design considerations for glass reinforced plastics have to take into account the good bond between the resin and fibers, and the elastic relations of the fiber. Conventional methods of testing for mechanical and physical properties of reinforced plastics are discussed, and the effects of various environmental conditions on the durability of the materials is pointed out. G.G.

N65-26367# Radiation Applications, Inc., Long Island City, N. Y.
UPGRADING OF POLYMERIC MATERIALS, OCTOBER 1-DECEMBER 31, 1963
31 Dec. 1963 22 p refs
(Contract DA-49-186-ORD-1095)
(RAI-330; AD-461434)

Work during this report interval has concentrated on cryogenic properties of irradiated polyethylene for the purpose of gaining further insight into resultant property improvements and to ascertain their value in relation to HDL requirements. Low temperature flexibility studies with both irradiated and unirradiated Marlex 5003 and 6009 have been performed. Flexibility studies were performed on 80 mil Marlex 5003 and 6009 specimens which had been subjected to uniform doses of 16, 32, 48, 64, and 80 Mrads. Author

N65-26433# Massachusetts Univ., Amherst. Polymer Research Inst.
SOME OPTICAL AND MECHANICAL PROPERTIES OF POLYVINYL CHLORIDE
A. Utsuo and R. S. Stein Jan. 1965 34 p refs
(Contract Nonr-3357(01))
(ONR-TR-79; AD-464060)

Optical and mechanical properties of polyvinyl chloride (PVC) were investigated including the birefringence change with stretching at various temperatures, the thermal stress and birefringence cycle between room temperature and 100° C, the dynamic stress and birefringence at room temperature, and an experiment on visible dichroism change with stretching. A negative birefringence was observed when PVC was stretched at a temperature lower than 40° C. At higher temperatures it showed positive birefringence which increased monotonically with stretching. The thermal stress cycle tendencies coincided with previous results but the thermal birefringence cycle decreased when the relaxation temperature was exceeded. Dichroism change of visible light with stretching, relaxation, and thermal cycle was examined on the thermally decomposed PVC. The PVC was unsuitable because of property changes. R.N.A.

N65-26560*# Schjeldahl (G. T.) Co., Northfield, Minn.
HEAT STABILIZATION STUDY OF ADVANCED MATERIALS Final Report
W. E. Palmquist and A. J. Wendt 5 Sep. 1963 108 p
(Contract NAS5-2834)
(NASA-CR-63460) CFSTI: HC $4.00/MF $0.75 CSCL 11I

The shrinkage characteristics of polypropylene films were investigated. It was determined that biaxially oriented polypropylene was the best material from the point of view of minimum shrinkage and maximum retention of basic strength for any given heat treatment temperature. Heat treatment of polypropylene in a glycerine bath at 160° C for 1 minute provides the most economical heat treatment to obtain minimum shrinkage. Tensile strength of this material falls off rapidly at 165° C and heat treatment above 160° C is not recommended. Optical tests of the transmission of polypropylene indicate indicate little variation between untreated material and the treated material, thereby indicating that the heat treatment does not affect the average optical transmission properties of the polypropylene. Also, heat treating methods were developed to reduce shrinkage of polypropylene laminates to as low as 2% for a hot-spot temperature of 100° C. The processes make fabrication of large spheres for satellite application possible. E.E.B.

N65-26561*# Schjeldahl (G. T.) Co., Northfield, Minn.
THE EFFECTS OF HIGH VACUUM AND ULTRAVIOLET RADIATION ON PLASTIC MATERIAL Final Report
George M. Miller 1 Sep. 1964 60 p refs
(Contract NAS5-2834)
(NASA-CR-63459) CFSTI: HC $3.00/MF $0.50 CSCL 11I

Samples of polypropylene and Mylar were investigated to determine the effects of simulated space conditions on these materials. It was determined that both heat treatment and an initial exposure in a restrained condition improve the ability of both materials to withstand the conditions of outer space. Heat treated Mylar exposed for 50 days shrunk 2.78% after being given an initial radiation exposure in a restrained condition. Polypropylene retracted 4.4% in the direction of restraint and considerable more in lateral direction in which it was not initially restrained. A hot-spot temperature of 15° C was calculated for the plastic portion of the polypropylene sample with a 4-mil thick aluminum web which was 90% milled. The calculated hot-spot temperature for Mylar was 84° C. The results indicated that the optical degradation of polypropylene will not be damaged by overheating in an outer space environment. Also, chemical milling runs were made to evaluate various resists and etchants. A process was developed using a copper chloride etchant which will mill a 90% open pattern in 4-mil aluminum. E.E.B.

N65-26562*# Schjeldahl (G. T.) Co., Northfield, Minn.
[CHEMICALLY MILLED ALUMINUM-POLYPROPYLENE LAMINATES AS SUITABLE MATERIALS FOR USE IN COMMUNICATION SATELLITES] Final Report
S. J. Stenlund and George Miller 13 Nov. 1964 74 p
(Contract NAS5-2834)
(NASA-CR-63458) CFSTI: HC $3.00/MF $0.75 CSCL 11I

Chemically milled aluminum-polypropylene laminates were established as suitable materials for use in communication satellites. In laboratory studies copper chloride was found to be the best etchant for thick aluminum and precision milling. Four-mil thick aluminum was chemically milled to 90% open area with little undercutting and excellent line definition. Also, in 50-day simulated space exposure tests it was demonstrated that polypropylene resists degradation more than Mylar and that hot-spot temperatures for poly-propylene will not exceed 15° C. Further, heating methods were developed which reduce shrinkage of aluminum-polypropylene laminates to as low as 2%. E.E.B.

N65-26624# Bjorksten Research Labs Inc., Madison, Wis.
DEVELOPMENT OF ANTI-AGGLOMERATION METHODS FOR DRY POWDERS Final Report
Luther L. Yaeger, Risto P. Lappala, and Joel N. Lipscomb Mar 1964 46 p refs
(Contract DA-18-108-AMC-171(A))
(AD-435773)

A technique was developed for successfully spray-drying saccharin and para-aminobenzoic acid from solvent systems of 70% acetone, 30% carbon tetrachloride. Particle sizes less than 10 microns in diameter were achieved. Incorporation of an anti-static agent, Catanac SN, markedly increased the flowability of the powders. A spray-dryer was designed and constructed with sufficient adaptability and simplicity to permit evaluation of various atomization devices (spinning disk, centrifugal pressure nozzle, impingement and pneumatic nozzles), hot-gas spray mixing procedure, powder collection and separation equipment. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-25692# RAND Corp., Santa Monica, Calif.
A NOTE ON THE SOLUTION OF POLYNOMIAL CONGRUENCES
Richard Bellman Mar. 1965 10 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-3898-PR; AD-612699)

The number of solutions of the congruence $f(x) \equiv 0(p)$, where $f(x) = x^n + a_1x^{n-1} + \cdots + a_n$, can be expressed in the form $N = \frac{1}{p} \sum_{t,x} e^{2\pi i t f(x)/p}$, where t and x run independently through the values $0,1,2,\ldots,p-1$. This result is an immediate consequence of the relation $\sum_t e^{2\pi i t y/p} = 0$, $y \not\equiv 0(p)$, $= p$, $y \equiv 0(p)$. In this note we present an alternative expression for the number of solutions of the congruence. Author

N65-25731# State Univ. of New York at Buffalo.
SOME PROPERTIES OF DISTRIBUTION FUNCTIONS AND TRANSFORMATIONS THAT INDUCE ONE ANOTHER
Paul J. Schillo and Norman C. Severo Wright-Patterson AFB, Ohio, ARL, Apr. 1965 91 p refs
(Contract AF 33(657)-9885)
(ARL-65-75; AD-616842)

Research on families of transformations of random variables and of distribution functions are given. Each of the families of transformations induces a fixed distribution function when a given random variable is subjected to any member of the family. Necessary and sufficient conditions are given under which a given family is a non-empty set. These conditions depend only on the saltuses of the induced distribution function and of the distribution function corresponding to the random variable being transformed. Each of the families of distribution functions induces a fixed distribution function when random variables associated with the family are subjected to a fixed transformation. Each family is treated as a convex subset of the function space whose points are Baire functions. Properties of the function space itself are developed in some detail and attention is given to the existence of boundary points of the convex subsets. Author

N65-25744# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics
HEREDITARY DEPENDENCE IN THE THEORY OF DIFFERENTIAL EQUATIONS, PART II
G. Stephen Jones Mar. 1965 48 p refs
(Contract Nonr-595(17))
(BN-391; AD-612648)

Continued research conducted under a program which focuses on the development of the qualitative theory of heredity dependence in the theory of differential equations, is reported. Presented is a mathematical analysis of the existence and uniqueness theorems for hereditary equations, and a theoretical study of the structure of hereditary dependence. Problems of continuation of solutions and dependence on initial data and parameters, are discussed. S.C.W.

N65-25764# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
AN ALGORITHM FOR CONCURRENT RANDOM WALKS ON HIGHLY PARALLEL COMPUTERS
R. F. Rosin (Ph.D. Thesis) Jul. 1964 110 p refs *Its* Rept.-04967-4-T
(Contract AF 30(602)-2661)
(TR-151; AD-460957)

The algorithm studied was presented and compared with the conventional nonconcurrent algorithm and with other concurrent algorithms. A measure of effectiveness of the new algorithm as compared to the conventional one is called G. The algorithm is analyzed for one-dimensional spaces with the source in the center. Study of G for simulation of symmetric random walks in two-dimensional spaces considers both spaces with square absorbing boundaries of various sizes, with centrally located sources, and simulations in spaces with irregular boundaries. The proposed algorithm is at least as effective as the conventional algorithm, and in many cases, e.g., small target sets, the new algorithm is more effective and can be predicted without random walk simulation. Author

N65-25771# Stanford Univ., Calif. Computer Science Dept.
THE DIFFERENCE CORRECTION METHOD FOR NON-LINEAR, TWO-POINT BOUNDARY VALUE PROBLEMS
Victor Pereyra 25 Feb. 1965 40 p refs
(Contract Nonr-225(37))
(CS18; AD-612478)

The numerical solution of non-linear two-point boundary value problems is discussed. It is shown that for a certain class of finite difference approximations the a posteriori use of a difference correction raises the order of the approximation by at least two orders. The difference correction itself involves only the solution of one system of linear equations. If Newton's method is used in the early stage, then it is shown that the matrices in both processes are identical, which is a useful feature in coding the method for an automatic computer. Several numerical examples are given. Author

N65-25785# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
PROGRAMMING UNDER UNCERTAINTY: THE EQUIVALENT CONVEX PROGRAM
Roger Wets Feb. 1965 42 p refs *Its* Mathematical Note No. 392
(DI-82-0411; AD-612896)

The equivalent convex program of a two-stage linear program under uncertainty is described in two parts: (1) the properties of the solution set of the problem and the derivation of explicit expressions for particular cases and (2) the derivation of the objective function of the equivalent program, which is both convex and continuous. A necessary condition for its differentiability is given and necessary and sufficient conditions for the solvability of the problem are established. The equivalent convex program of certain classes of programing under uncertainty problems, i.e. when the constraints and the probability space have particular structures, are given. Author

N65-25804 Joint Publications Research Service, Washington, D. C.
METRIC SPACE OF EVENTS, I
V. G. Bodnarchuk *In its* Cybernetics 9 Jun. 1965 p 56–67 refs (See N65-25800 15-08) CFSTI: $6.00

An attempt to introduce a metric into event space G (impossible and single events) and to prove, on this basis, several theorems concerning the properties of a certain class of equations, is reported. Considered in the analysis are monotonic and converging sequences, and nonsingular and isotonic properties. Results are extended to consider the space of n-dimensional vectors whose components serve as the elements of G, in place of the event space G. S.C.W.

N65-25805 Joint Publications Research Service, Washington, D. C.
SOME ASPECTS OF ABSTRACT AUTOMATON ANALYSIS BY MEANS OF EQUATIONS IN THE ALGEBRA OF EVENTS
M. A. Spivak *In its* Cybernetics 9 Jun. 1965 p 68–70 refs (See N65-25800 15-08) CFSTI: $6.00

A new method for use in the analysis of abstract automata, which focuses on the development of shorter and simpler computations for the solution of a system of equations in the algebra of events, is reported. The advantages of the proposed method over existing methods are: (1) equations are composed directly from the transfer table of the automaton and do not require finding the matrices of the direct transfers; and (2) for any number of representative states, the sought event enters directly into the system as one of the unknowns. S.C.W.

N65-25806 Joint Publications Research Service, Washington, D. C.
AUTOMATON SUBSTITUTIONS AND INTERLACEMENTS OF GROUPS
V. P. Zarovnyy *In its* Cybernetics 9 Jun. 1965 p 71–94 refs (See N65-25800 15-08) CFSTI: $6.00

A study of the relationship between the automaton substitution groups A(n), which were obtained from a countable set of symmetric groups of n-th degree; and the interlacements of groups K(n,r), which are similar to the interlacement of r symmetric groups of n-th degree, but do not coincide with them, is reported. Presented are mathematical analyses of several theorems concerning dual interlacement of groups, and the automaton-finiteness of the automaton mapping.
S.C.W.

N65-25807 Joint Publications Research Service, Washington, D. C.
A GROUP OF RECIPROCALLY SINGLE-VALUED TRANSFORMATIONS DETERMINED BY FINITE AUTOMATA
Ferents Gecheg *In its* Cybernetics 9 Jun. 1965 p 95–102 refs (See N65-25800 15-08) CFSTI: $6.00

Based on the assumption that $X = (x_1,...,x_n)$ is a finite set of symbols and F(X) is a free semigroup generated by the set X, and that all the one-to-one mappings (G_X) of the semigroup F(X) represent a group relative to conventional multiplication, a theory is proposed which states that in the case $\overline{X} \geq 2$, the group G_X is not finitely induced. Emphasized are the superpositions of the automata $A_j (j = 1,...,v)$ which have common input and output alphabets X, if in the case $1 \leq j \leq v-1$ the output of automaton A_j is only related to the input of automaton A_{j+1}. It is shown, in the final proof of the theory, that neither the group of all the one-to-one mappings of the semigroup F(X) on itself, induced by finite automata; nor the semigroup of all the mappings of the semigroup F(X), induced by finite automata; have a finite system of generators when $\overline{X} \geq 2$. It is concluded that, it is impossible to find any finite collection of automata whose superposition could accomplish any sorting of information, regardless of whether information is lost in the process. S.C.W.

N65-25809 Joint Publications Research Service, Washington, D. C.
SEQUENTIAL ALGORITHMS OF OPTIMIZATION AND THEIR APPLICATION. I
V. S. Mikhalevich *In its* Cybernetics 9 Jun. 1965 p 115–150 refs (See N65-25800 15-08) CFSTI: $6.00

Presented is a theoretical analysis of a general scheme of sequential search, which considers several general hypotheses concerning the sequential selection of optimal decisions in the control of processes under indeterminate conditions. Also considered is the use of sequential algorithms for the optimal control of systems along with previous theory concerning the possible reduction of the problem of the selection of optimal decisions to the sequential two-player game. Data on the applicability of this scheme to the study of several classes of multivariate optimization problems, the theory of sequential statistical decisions, and the sequential recognition of patterns, are included. Included is a survey of the numerical solution of several problems of optimal design and planning. S.C.W.

N65-25810 Joint Publications Research Service, Washington, D. C.
LIMIT BEHAVIOR OF A CLOSED SYSTEM OF RANDOM INPUT AUTOMATA
N. V. Yarovitskiy *In its* Cybernetics 9 Jun. 1965 p 151–164 refs (See N65-25800 15-08) CFSTI: $6.00

Considered is the finite sequence $|C_k|$ $(k = \overline{1, s})$ of elements c_k, each of which possesses two inputs and one output. Based on the assumptions that the output of each element is connected to one of the inputs of the following element $c_k + 1$, that the output of the element c_s is connected with one of the inputs of the element c_1, and that the system considered functions in the discrete time regime in the sense that this is used in the structural theory of automata, a study is presented which focuses on the clarification of the limiting behavior of the states of the system elements at an instant of time infinitely removed from the initiation of the process. Presented are theoretical analyses of the existence of stationary distributions of the states, and the state generating functions of the system elements. Included are expressions for deriving the input alphabet of the system, the input and output alphabet of each of the elements c_k, transfer and output functions, the moments of distribution of the states of the individual elements of the system, the moments of the sum of the system states, and the mathematical expectation of a stationary distribution. S.C.W.

N65-25811 Joint Publications Research Service, Washington, D. C.
MATHEMATICAL PROCESSING OF ONE CLASS OF BIOCHEMICAL EXPERIMENTS
V. V. Shkurba *In its* Cybernetics 9 Jun. 1965 p 165–179 ref (See N65-25800 15-08) CFSTI: $6.00

Presented is a study designed to prove the validity of the hypothesis that supplementary feeding of *Drosophila melanogaster* larvae with DNA preparations will cause mutations affecting entire portions of the chromosomes. Proposed is an algorithm for the transformation of the matrix $(\delta_{i\ j})$ of the experimental results to a matrix having the primary property. It is shown that by using the proposed method, all possible variants of the solution of the problem can be found, even in the presence of experimental error. Also included is a parallel study to determine whether a similar pattern could be observed for random mutations uniformly distributed over the chromosome. Results indicate the positive probability of the transformation of the matrix (δ^P_{ij}) to the matrix possessing the primary property for values close to 0.3. S.C.W.

N65-25812 Joint Publications Research Service, Washington, D. C.
ALGORITHM OF SOLUTION OF ONE PROBLEM OF SELECTION
Yu. E. Guliyev and N. A. Mamed-Zadhe *In its* Cybernetics 9 Jun. 1965 p 180–183 ref (See N65-25800 15-08) CFSTI: $6.00

Proposed is an algorithm for use in solving selected problems without using the technique of linear programing. Presented is a theoretical analysis of a problem which involves the selection of the most valuable load for an airplane of load capacity M, from n different objects in which the weight of the i-th object is equal to α_i while its value is equal to β_i. Considered is the selection of the object for which the average value of all objects is maximal, and the selection of the object for which the average value is maximal, for obtaining one or several optimal solutions. Included is an analysis of the case in which there are given n groups of objects and each group consists of a_i objects differing in weight and value. A brief discussion of the overall number of basic computational operations involved in using this method, is also presented. S.C.W.

N65-25937# North Carolina Univ., Chapel Hill. Psychometric Lab.
BAYESIAN DECISION THEORY, GAME THEORY AND GROUP PROBLEM SOLVING
David M. Messick Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1964 17 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-64-603; AD-614683)

Concepts of the ideal information-processor and rational decision-maker to a group problem solving are presented. The structure of the selected task is seen as a nonzero sum game. A strategy is derived which is the equivalent of the Nash solution to the game. The notion of level of aspiration is discussed and defined within the analysis, and two theorems are proved relating level of aspiration to type of group decision strategy employed. Author

N65-25940# California Univ., Berkeley. Operations Research Center
GENERALIZED UPPER BOUNDED TECHNIQUES FOR LINEAR PROGRAMMING—II
George B. Dantzig and Richard M. Van Slyke Feb. 1965 26 p ref
(Contract Nonr-222(83))
(ORC-64-18; AD-614577)

A variant of the simplex method is given for solving linear programs with M + L equations, L having the property that each variable has at most one nonzero coefficient. Special cases include transportation problems, programs with upper bounded variables, and assignment and weighted distribution problems. The algorithm described uses a working basis of M rows for pivoting, pricing, and inversion, which for large L can result in a substantial reduction of computation. This working basis is only M × M and is a further reduction of the size found in an earlier version. To achieve this reduction, row as well as column transformations must be made. Author

N65-25942# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
STUDIES IN RESEARCH METHODOLOGY. VI: THE CENTRAL LIMIT EFFECT FOR A VARIETY OF POPULATIONS AND THE ROBUSTNESS OF Z, t, AND F
James V. Bradley Dec. 1964 199 p refs
(AMRL-TR-64-123; AD-612886)

The robustness of Z, t and F tests was studied by obtaining 1220 empirical sampling distributions (some of which were later combined) each consisting of 10,000 values of the test statistic obtained under a unique combination of sampling conditions. Conditions investigated, both alone and in combination, were: population shapes (nonnormal, normal, or some nonnormal and others normal), population variances (all σ^2, or some σ^2 and others $\sigma^2/4$), relative sample sizes (for two-sample tests N,N; 2N,N; 3N,N; or 2N,2N; for other multisample tests N,N,N; 2N,N,N; or N,N,N,N), and absolute sample size (N assumed values of 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, and in four special cases 2048 and 4096). Robustness at nominal significance levels of .05, .01, and .001 was examined for both left-, right- and two-tail tests. The Central Limit effect upon means of samples from populations differing considerably in shape and "degree of nonnormality" was revealed in the robustness of certain Z statistics. Results showed that robustness varies drastically with conditions which are mentioned neither in the statement of the assumption which was violated nor in the claim, as usually propounded, that the test is robust against that violation. In general, results were inconoclastic with regard to general, unqualified, allegations of robustness. Author

N65-26004# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A NOTE CONCERNING THE COLLINEAR LIBRATION CENTERS Mathematical Note No. 379
Andre Deprit Jan. 1965 24 p refs
(DI-82-0392; AD-612805)

The synodical barycentric abscissae of the collinear libration centers L_1 and L_2 are expanded in power series of the cubic root of the mass ratio up to the seventh order. A proof given by A. Wintner concerning an essential property of the characteristic exponents at the collinear Lagrangian points is shown to be wrong and is corrected. Through numerical computation for different values of the mass ratio, it is found that the absolute value of both characteristic exponents at L_1 and L_3 is a strictly increasing function of the mass ratio on the interval (0,1/2), while, at L_2, it is a strictly decreasing function. Author

N65-26009# New York Univ., N. Y. Courant Inst. of Mathematical Sciences
ON SOME TESTS OF HOMOGENEITY OF VARIANCES
Madan L. Puri Mar. 1965 19 p refs
(Contract Nonr-285(38))
(IMM-NYU-338; AD-613067)

In their paper, Ansari and Bradley discussed a two-sample rank test for dispersions and suggested the desirability of extending their results to the problem of several samples. In this paper, besides generalizing their results, we provide a few additional non-parametric tests, which include, among others, the multi-sample analogues of the two-sample normal scores test of dispersion and the tests considered by Mood, Klotz, and Siegel and Tukey. The asymptotic distributions of the proposed test statistics are derived by an application of the author's theorem. The asymptotic efficiencies of these tests relative to one another and the F test are computed in the standard fashion along the lines of the author's paper. Author

N65-26035# Joint Publications Research Service, Washington, D. C.
MATHEMATICAL MODEL OF DEVELOPMENT
L. V. Smirnov 11 Jun. 1965 12 p refs Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 1, 1965 p 67–73
(JPRS-30579; TT-65-31253) CFSTI: $1.00

The concepts of mathematical models for systems of motion and development are described, and are discussed in the frameworks of physics, biology, sociology, and economics. The classical models of motion are deterministic, in which the state of being of an object depends on its distance along some axis such as time. Many models of this type are found in physics and economics. The model of development is more complex, and generally more realistic, since it allows for the occurrence of principally new conditions which are associated with probabilities. Examples of these models can be found in the physical theory of particle motion, medical theory of epidemics, and statistical theory of population growth. The idea of the Markov chain is discussed in detail as an example of a model of development; this model specifies a series of stages, and at each stage a number of different events can occur with probabilities which depend only on the outcome at the immediately preceding stage. J.M.D.

N65-26106# Oklahoma Univ., Norman. Graduate Coll.
THE DEVELOPMENT AND ANALYSIS OF A TWO STATION SEQUENTIAL QUEUING SYSTEM
Joseph Adamo (M.S. Thesis) 1965 53 p refs
(AD-612251)

The work is concerned first with development and analysis of a two station sequential system with no queue allowed. Then, systems with no queue before first station maximum of one, two, and three units respectively between stations are considered. TAB

N65-26176 Joint Publications Research Service, Washington, D. C.
PROCEDURES FOR QUANTITATIVE ANALYSIS OF COMPLEX SYSTEMS, 1
D. B. Yudin *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 1–15 refs (See N65-26175 15-10) CFSTI: $7.00

Mathematical programming is considered as a method of investigation and synthesis of complex systems. A short review is presented of the contemporary state of mathematical programming and classification of procedures for solution of nonlinear extremal problems. New approaches to the analysis of multi-extremal problems are noted. Author

N65-26177 Joint Publications Research Service, Washington, D. C.
ON SOME CLASSES BY COMPLEX SYSTEMS, II
I. N. Kovalenko *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 16–26 refs (See N65-26175 15-10) CFSTI: $7.00

The investigation of a class of complex systems is continued. The class of functionals which describe the effectiveness of the system is introduced. The problem of complexity of simulation of a system is investigated. Properties of the process retained in passage through a unit are investigated. Author

N65-26178 Joint Publications Research Service, Washington, D. C.
A FATIGUE–REST MODEL
N. N. Vorob'yev, F. S. Kislitsyn, and A. S. Mikhaylova *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 27–37 refs (See N65-26175 15-10) CFSTI: $7.00

A mathematical model describes the process of doing work in which fatigue is compensated by rest periods. While the model cannot be applied directly to actual labor activities, it may be of use with such phenomena as cooling or heating. For optimal behavior or functioning, it is shown that the system should get to the fixed condition, or maximum work output, in a minimum time; stay in this condition for an indefinite period; and finish the operation in a state of maximum efficiency. An example is presented, with propositions and their proofs. M.W.R.

N65-26179 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF PYRAMIDAL SYSTEMS FROM MAJORITY ELEMENTS
V. I. Varshavskiy and L. Ya. Rosenblum *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 38–46 ref (See N65-26175 15-10) CFSTI: $7.00

Problems in synthesis of so-called pyramidal systems from majority elements are investigated. The possibility of convolusion of expansion according to Lindeman and Cohn is shown in the general form. Another type of expansion into a mixed expansion is proposed. Author

N65-26182 Joint Publications Research Service, Washington, D. C.
ALGORITHM FOR ABSTRACT SYNTHESIS OF AUTOMATA FOR AN EXPANDED LANGUAGE OF REGULAR EXPRESSIONS
M. A. Spivak *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 70–80 refs (See N65-26175 15-10) CFSTI: $7.00

The problem of abstract synthesis of an automaton is investigated where the conditions of operation are written in a language of regular expressions containing in addition to the usual symbols the symbols $\cap$ and ' corresponding to the intersection and complementation of events. The algorithm is indicated for solution of this problem. The solution is based on expansion of a given regular expression with respect to some system of regular expressions called basic. Also use of expansion with respect to a base for conversion and simplification of regular expressions is pointed out. Author

N65-26352# California Univ., Berkeley. Operations Research Center
A TWO-LANE TRAFFIC MODEL
Robert M. Oliver Feb. 1965 28 p
(Grant NSF GP-2633)
(ORC-64-34)

A mathematical model of a simple two-lane road was tested on actual highways to evaluate lane-changing and passing maneuvers. On the assumptions that the total number of vehicles are conserved and that lane changes are related to the densities in each lane, nonlinear differential equations were obtained based on changes in flow rates and densities within a differential element of time and road length. Equations of continuity for flow rate, density of vehicles, and velocity are given. Equilibrium solutions are obtained by defining normalized velocities in each of the lanes. Stability and certain qualitative features of the transient solution were ascertained. It was concluded that in the lane of departing vehicles, flow rates are proportional to the square of the number of vehicles in a lane. More vehicles create more lane changes as well as a greater desire to change lanes because of the general undesirability of driving on a crowded road. M.W.R.

N65-26359# Atomics International, Canoga Park, Calif.
ANALYSIS OF STRESSES IN BELLOWS. PART II: MATHEMATICAL
W. F. Anderson 27 May 1965 158 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-4527; Pt. II)

A method of analysis for stresses in toroidal shells has been developed which is applicable to a wide range in the geometrical parameters involved. Application of this method to the problem of analysis for stresses in bellows has provided results consistent over a full range of the parameter μ with the results of other methods which are limited in application to the range of low or high values of μ. Digital computer solutions using combinations of parameters with variations in boundary conditions have provided data for stress factor charts to be used in design analysis of bellows applications as presented in Part I of this report. The method outlined can probably be applied with equal facility to other problems of toroidal shells. Author

N65-26397# Illinois Univ., Urbana. Coordinated Science Lab.
A TABULATION OF SOME SEMICONDUCTOR INTEGRALS
Engineering Experiment Station Circular No. 84
Richard M. Brown and Norman K. Hindley 1964 20 p refs
Its Bull. Vol. 61, No. 86, May 1964
(Contracts DA-36-039-AMC-02208(E); Nonr-1834(12))

The integrals A(p,x) and E(p,x) used in calculations of the effects of high frequency electrical fields and/or steady uniform magnetic fields on the theoretical properties of metals and semiconductors are evaluated and tabulated versus the

square root of the argumant x. These tables were computed in Fortran to five figures in small enough tabulation intervals to insure accurate linear interpolation for most cases. G.G.

N65-26435# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
A MODIFIED LEAST SQUARES REDUCTION TECHNIQUE FOR INTERFEROGRAMS
James W. Bradley Nov. 1964 30 p refs
(BRL-MR-1618; AD-463925)

A simple interferogram reduction technique is proposed whereby the density is obtained as a polynomial whose coefficients are related to the corresponding coefficients of a least squares fit to the fringe shift data. Author

N65-26446# Duke Univ., Durham, N. C.
ERROR ESTIMATE IN PREDICTIONS OF ORBITAL ANGLES
W. E. Sewell, G. J. Kurowski, L. E. Winslow, H. L. Parker, and J. D. Watson 10 Jan. 1964 122 p ref
(Contract DA-31-124-AROD-13)
(Memo.-64-1-1-10; AD-461436)

The capabilities of angles-only input data for satellite orbital predictions were analyzed through determination of the following parameters of the satellite's elliptical orbit: (1) semimajor axis length; (2) eccentricity; (3) angle between the orbital plane and the North Pole; (4) angle between the major axis and the line which is the intersection of the orbital and equatorial planes; (5) angle between a fixed x-axis in the equatorial plane and the line of nodes; and (6) a constant of integration in the equation of motion. The estimated error in the predicted values of the time and aximuth of the satellite were based on an initial sequence of observations at the tracking station. It was concluded that a prediction period of 15 to 20 days can be obtained by proper selection of the observation orbit. The results are plotted in graphs, and the data are presented in an appendix. G.G.

N65-26580 Eidgenossische Technische Hochschule, Zürich (Switzerland). Forschungsinstitut für Mathematik
GROUPS OF HOMOTOPY CLASSES
M. Arkowitz and C. R. Curjel Berlin (New York), Springer-Verlag, 1964 40 p refs Lecture Notes in Math. No. 4

This report contains abstracts of published Soviet research on the subject of mixing of concentric high velocity airstreams. Discussed are: (1) turbulent air jets heated to 4000° K; (2) turbulent wake and jet in a current stream in the presence of the longitudinal pressure gradient; (3) a turbulent isothermal jet in a current flow; (4) numerical calculation of high temperature laminar jets; (5) calculation of noncylindrical ejector; (6) mixing of gas streams; (7) the influence of initial turbulence on the boundaries and range of submerged jets; (8) the theory of differential ejector; (9) hypothesis on the generalization of ejector characteristics of turbulent gas jets and its application; and (10) thickness of the turbulent mixing zone on the boundary of two streams of gases of different velocities and densities. N.E.A.

N65-26606# California Univ., Berkeley. Operations Research Center
MISSING VALUES IN MULTIVARIATE STATISTICS: HISTORICAL REVIEW AND LEAST SQUARES ESTIMATION WITH TWO VARIABLES
R. M. Elashoff and A. A. Afifi Jan. 1965 58 p refs
(Grants PHS-GM-9606-04; NSF GP-2633)
(ORC-65-5)

Several methods are defined for constructing competing estimation procedures for the regression function of one or more dependent variables on one or more independent variables from a random sample of n vector observations, where the components of the vector are the dependent and independent variables. The probabilistic behavior of each procedure is determined and compared with each other to find a criterion where there exists one dependent and one independent variable. It was concluded that no estimation technique is uniformly best. Qualitative as well as quantitative comparisons can be made for any given situation by using the formulas for conditional and unconditional mean square errors considered in this study. G.G.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-25603# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM METEOROLOGIYA I GIDROLOGIYA (METEOROLOGY AND HYDROLOGY), NO. 4, 1965
27 May 1965 101 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 4, 1965
(JPRS-30277; TT-65-31090) CFSTI: $4.00

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N65-25604 Joint Publications Research Service, Washington, D. C.

INTERPOLATION OF METEOROLOGICAL FIELDS USING A SPACE-TIME CORRELATION FUNCTION

B. V. Ovchinskiy *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 1–12 refs (See N65-25603 15-20) CFSTI: $4.00

Where the values of a meteorological element, X_i, are known at some n points, and it is wished to determine the unknown value X_0 at some additional point, a method is described which takes into account earlier information about the n points. This is an extension of an established method in which X_0 is determined as a weighted sum of the previous n values, where the weights are chosen so as to minimize the expected squared difference between the theoretically true X_0 and the weighted sum. An example would be observations made on successive days where weather conditions interrupt the series and the missing observation must be estimated. In this model it is specified that each observation is subject to experimental error, and that the successive observations are correlated. The mathematical technique of least-squares is applied in obtaining an estimate of X_0 and a measure of the error of estimation. J.M.D

N65-25605 Joint Publications Research Service, Washington, D. C.

ROLE OF RADIATION PROCESSES IN ATMOSPHERIC THERMODYNAMICS

P. N. Belov and A. F. Kivganov *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 13–21 refs (See N65-25603 15-20) CFSTI: $4.00

The role of nonadiabatic processes, particularly radiant energy, in numerical weather forecasting is analyzed theoretically. A method for calculating fluxes is presented, and is applied to a problem in computing the effective fluxes of long-wave radiation and the fluxes of short-wave radiation, temperature changes for the principal isobaric surfaces, and the hourly changes in height of 200-, 500-, and 850-mb surfaces. Analysis of the method and the computed results indicate the need to take the radiative influx of heat into account in numerical forecasting of temperature and pressure. J.M.D.

N65-25606 Joint Publications Research Service, Washington, D. C.

THUNDERSTORM FORECASTS AND THEIR POSSIBLE IMPROVEMENT

S. I. Ponomarenko *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 22–27 refs (See N65-25603 15-20) CFSTI: $4.00

Various computational methods for predicting thunderstorms were compared for 18 weather stations in the USSR during the summer of 1963. The best of these techniques was only 40% reliable and a synoptic investigation of sources of forecasting errors resulted in refinements in the methods. These refined methods were tested again at the same stations for the summer of 1964; the results were better but still below the level of practical requirements. This inadequacy is due not only to imperfection in predicting thunderstorms, but to unreliable forecasts of the trajectories of transport of air particles at the earth's surface and aloft, and also to inadequate forecasts of temperature and dew point. J.M.D.

N65-25607 Joint Publications Research Service, Washington, D. C.

PRACTICAL USE OF RADIATION DATA FROM METEOROLOGICAL SATELLITES

K. Ya. Kondrat'yev *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 28–39 refs (See N65-25603 15-20) CFSTI: $4.00

The uses of satellite observations of outgoing terrestrial radiation in determining cloud distributions, cloud height, earth temperature, tropospheric humidity, and vertical atmospheric movement, are discussed generally. It is expected that information on the field of terrestrial radiation can be of greater meteorological value than satellite observation by television or photographic methods. J.M.D.

N65-25609 Joint Publications Research Service, Washington, D. C.

THE "ATMOSFERA", A CENTRALLY INTERCONNECTED COMPUTER TELEMETRIC SYSTEM FOR PROCESSING RADIOSONDE DATA

P. L. Yefimov *In its* Transl. from Meteorol. i Gidrol. (Meteorol. and Hydrol.), No. 4, 1965 27 May 1965 p 49–57 (See N65-25603 15-20) CFSTI: $4.00

The Atmosfera computer system for automatic reception, analysis, and transmission of aerological information to weather stations is described. This computation-telemetry system consists of a sounding station and a field computation center which are interconnected by communication channels. The sounding station automatically records the signals of a radiosonde arriving from the receiver of a radiotheodolite and transforms them into a compressed coded form. This is fed by way of telegraph lines to the computation center. Tests of this system revealed that errors caused by coding atmospheric pressure, humidity, and wind velocity are within the allowable limits for Atmosfera, but those due to coding temperature, dew point, and wind direction exceed the limits. In general, these errors are less than those inherent in manual processing of such data. J.M.D.

N65-25678# RAND Corp., Santa Monica, Calif.

THE EFFECT OF ELECTRIC CHARGES AND FIELDS ON THE COLLISIONS OF VERY SMALL CLOUD DROPS

M. H. Davis Apr. 1965 8 p refs Prepared for the Proc. of the 1965 Intern. Conf. on Cloud Phys., Tokyo, May 1965 (P-3099; AD-613650)

Using Hocking's hydrodynamics it was estimated that electrostatic forces began to produce collisions in droplets with radii under 15 microns when α exceeded 0.01 esu/cm^2. The effect was most important when the droplets were nearly the same size. Author

N65-25774# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group

METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXVII: SEPTEMBER 1964 FIRINGS Data Report Mar. 1965 269 p (IRIG-109-62; AD-464412)

Radiosonde observations nearest the time of firing, provided such observations were within ±6 hrs, are included together with wind and temperature measurements. Since only those firings which yield significant information are of interest, unsuccessful firings are not included. The data were derived from 122 rocketsonde observations. The types of rockets and their temperature and wind sensor instrumentation systems are identified on the appropriate charts and by code on the corresponding data sheets. Wind data were obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time increment into average velocity components. Temperature instrumentation, for measuring temperature directly, consisted of modified 1680 Mc radiosonde transmitter units and bead thermistor sensors. E.E.B.

N65-25829# Technische Hochschule Fridericiana, Karlsruhe (West Germany). Meteorologisches Inst.
THE STRUCTURE OF CLOUDS AND RAIN AND THE FORMATION OF PRECIPITATION Final Technical Status Report, Jun. 1, 1963–May 31, 1964
M. Diem Dec. 1964 72 p refs
(Contract DA-91-591-EUC-2891)
(AD-612884)

A study of the variation in size of raindrops during their fall through free atmosphere is reported. Measurements of the structure of precipitation were made at ground level and at a height of 150 m on a tower. Collecting filters were exposed at right angles to the rain; the spots on the filters were sorted according to size by an optical analyzer. Four causes of variation in size—coagulation, condensation, evaporation, and breakup—are discussed. Analysis of data on fourteen rainstorms shows that width of the distribution of rain particle size varies directly with wind velocity. Values calculated from drop size and number, such as intensity of precipitation, water content, and radar reflectivity, show differences between the tower platform and the ground. Radar reflectivity was found to be poorly correlated with intensity of precipitation. J.M.D.

N65-25877# Defence Research Board, Ottawa (Ontario).
IS THE BRIKNER (BRUCKNER) CYCLE REAL?
S. I. Kostin May 1965 4 p Transl. into ENGLISH from Priroda (Moscow), no. 2, 1965 p 78–79
(T-425-R)

At the beginning of the 1880's, it was established that climatic conditions underwent cyclic fluctuations. In each cycle, of duration about 35 years, a period of humid and cold years is followed by one of dry, high-temperature years. By the investigation of the deposition of lacustrine silts, data were obtained which confirms the cyclic fluctuations. The silt layers formed in the warm season and in the cold season have different colorations, compositions, and structural characteristics. An investigation of these layers of the Pertozero silt deposits over a 4000-year period showed that the cyclic fluctuations are real, but the cycle duration fluctuates within wide limits. There is also considerable variation in the humidity indices of the individual cycles. Also, when there are small fluctuations of the indices, the climate cycle is weakly manifested; this, it appears, is what caused some researchers to doubt that the cyclic fluctuations really exist. E.E.B.

N65-26025# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXIX: JANUARY 1964 FIRINGS Data Report
Dec. 1964 233 p
(IRIG-109-62; AD-461403)

Wind and temperature measurements from available rocket network firings and a number of meteorological organizations engaged in upper atmospheric studies, are presented for January 1964. Included are radiosonde observations nearest the time of firing, provided they are within ±6 hours. Data from unsuccessful firings are not included. Reported data were derived from a total of 114 rocketsonde observations. Charts and corresponding data sheets are included on the types of rockets used, and their temperature and wind sensor instrumentation systems. Among the rocket types employed were the Hasp-I and -II, the Metroc, the Raven, and the Hopi-Dart. Wind data were obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time increment into average velocity components. Temperature instrumentation consisted of modified 1680 Mc radiosonde transmitter units and bead thermistor sensors. Also included is an addendum which contains data on: rocket launch time, wind and temperature sensors, instrumentation calibration, questionable data, wind and temperature height (top and bottom), rocket and component winds, density, altitude, and relative humidity. S.C.W.

N65-26026# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXX: FEBRUARY 1964 FIRINGS Data Report
Jan. 1965 253 p
(IRIG-109-62; AD-461404)

Wind and temperature measurements from available Network firings and a number of meteorological organizations engaged in upper atmospheric studies, are presented for February 1964. Included are radiosonde observations nearest the time of firing, provided they are within ±6 hours. Data from unsuccessful firings are not included. Reported data were derived from a total of 114 rocketsonde observations. Charts and corresponding data sheets are included on the types of rockets used, and their temperature and wind sensor instrumentation systems. Among the rocket types employed were the Loki-I, the Arcas, the Roksonde-200, and the Nike Cajun. Wind data were obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time increment into average velocity components. Temperature instrumentation consisted of modified 1680 mc radiosonde transmitter units and bead thermistor sensors. Also included is an addendum which contains data on: rocket launch time, wind and temperature sensors, instrumentation calibration, questionable data, wind and temperature height (top and bottom), rocket and component winds, density, altitude, and relative humidity. S.C.W.

N65-26076*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOME PRACTICAL ACCURACY CONSIDERATIONS OF SMOKE TRAIL WIND PROFILE DATA
Dennis W. Camp and James R. Scoggins 14 May 1965 32 p refs
(NASA-TM-X-53261) CFSTI: HC $2.00/MF $0.50 CSCL 04B

Wind velocity profiles measured simultaneously by the smoke trail/photographic method by different camera pairs, and photographs reduced twice for the same trail are analyzed to determine the relative accuracy of the smoke trail wind data. Arithmetic means, standard deviations, and extremes are given for the differences between five pairs of profiles.

Also presented are relative RMS errors in wind speeds, relative RMS errors in shears over height increments of 25, 50, 100 and 200 meters, and maximum shear differences for each case. The computed RMS differences in wind speeds are generally less than 1 meter per second, errors in wind shear vary to approximately 60 percent of the values used in vehicle design studies, and relative RMS errors in wind speeds range from approximately 0.1 to 0.7 meters per second. The sources of the errors are not isolated. These errors will probably be reduced as more experience is gained in data reduction and quality control procedures are improved. Author

N65-26143# Raven Industries, Inc., Sioux Falls, S. Dak.
TEMPERATURE AND WIND DATA, SKYHOOK CHURCHILL 1964
G. W. Fendrich 31 Jan. 1965 45 p
(Contract Nonr-3390(12))
(Rept.-2465; AD-612938)

N65-26275# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
NIKE-APACHE SPEEDBALL II (ROUND NO. 74 SN 30) Meteorological Data Report
Gerdon L. Dunaway Jun. 1965 50 p
(ERDA-322; AD-464527)

Meteorological data collected for the launching of NIKE-APACHE Speedball II, Round No. 74, SN 30, are presented for the Physical Sciences Laboratory of New Mexico State University, the U.S. Naval Research Laboratory, and for future ballistic studies. The meteorological data and resulting ballistic data appear in tabular form. Author

N65-26311# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Meteorological Working Group
RANGE USERS METEOROLOGICAL REQUIREMENTS
Jan. 1965 157 p
(IRIG-106-64; AD-461406)

User requirements for meteorological data on wind, temperature, humidity, and density are summarized. Much of the material is concerned with the designing and testing of structural and propulsion components of missiles and boosters. This concentration of interest is reflected in the predominance of requirements for data up to 400 000 feet. Additionally, an independent study is included to demonstrate a few of the parameters which may be more typical of future meteorological requirements. E.E.B.

N65-26365# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME XXXII: APRIL 1964 FIRINGS Data Report
Sep. 1964 188 p
(IRIG-109-62; AD-461405)

Wind and temperature measurements from all network firings during April 1964 are reported, together with radiosonde observation data within ±6 hours of the firing time. The types of rockets and their temperature and wind sensor instrumentation systems are identified on the charts and by code on the corresponding data sheets. G.G.

N65-26437# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.114 GG Meteorological Data Report
Marjorie Mc Lardie Hoidale May 1965 44 p refs
(ERDA-313; AD-463059)

Meteorological data gathered for the launching of Aerobee NASA 4.114 GG are presented for the National Aeronautics and Space Administration and for ballistic studies. The data appear, along with calculated ballistic data, in Appendixes A, B, C and D. Author

N65-26450# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, NEW ENGLAND Annual Report, 1961
E. J. Smith, E. E. Adderley, and F. D. Bethwaite Oct. 1963 105 p

Presented are the results for cloud-seeding operations during 1961. The total rainfall in north-seeded periods of New South Wales was much more than that in south-seeded periods. The overall double ratio after four years' operation is 1.094, with a high in autumn and spring, and with cumulus clouds. It was concluded that the rainfall figures for the discussed year are in the reverse sense to that expected if seeding caused an increase in rainfall. G.G.

N65-26451# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, NEW ENGLAND Annual Report, 1962
E. J. Smith, E. E. Adderley, and F. D. Bethwaite Dec. 1963 92 p

A cloud seeding experiment has been conducted in New England, New South Wales, Australia, to determine the amount by which seeding clouds with silver iodide smoke released from an aircraft can increase precipitation in this area. A brief description of the experiment is given together with a report of the fifth year's operation. It was concluded that the fifth year's operation of the experiment was satisfactorily concluded. The rainfall figures suggest a substantial increase caused by seeding. N.E.A.

N65-26452# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, SNOWY MOUNTAINS Annual Report, 1955
E. J. Smith, E. E. Adderley, and F. D. Bethwaite Apr. 1964 68 p

This is the first of a series of reports on a cloud seeding experiment that took place during the five years 1955 to 1959 inclusive, in the Snowy Mountains of South Eastern Australia. The clouds were seeded with silver iodide smoke released from an aircraft and efforts were made to determine whether this procedure could produce an economically significant increase in precipitation over a catchment area which is associated with important hydroelectric and irrigation works. A description of the experiment is given. It was concluded that the experiment made a fairly successful start. From the operational point of view the main limiting factor was the restriction on the aircraft flying in inclement weather. Precipitation figures suggest that cloud seeding caused an increase in precipitation. N.E.A.

N65-26453# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, WARRAGAMBA Annual Report, 1963
E. J. Smith, E. E. Adderley, and F. D. Bethwaite Jun. 1964 114 p

A four year cloud seeding experiment was conducted in the Warragamba Catchment, near Sydney, Australia, in which clouds were seeded with silver-iodide smoke released from an aircraft, with random choice of two areas. In the fourth year's operation the rainfall figures were in the reverse sense to that expected if seeding were successful. The combined figures for the four years are consistent with seeding having caused no detectable overall effect but suggest that increases have been caused in Cumulus clouds and reductions in Stratiform clouds. Author

N65-26454# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, SNOWY MOUNTAINS Annual Report, 1956
E. J. Smith, E. E. Adderley, F. D. Bethwaite, and J. A. Warburton Sep. 1964 86 p

This is the second of a series of reports on a cloud seeding experiment that took place during the five years 1955 to 1959 inclusive, in the Snowy Mountains of South Eastern Australia. The clouds were seeded with silver iodide smoke released from an aircraft and efforts were made to determine whether this procedure could produce an economically significant increase in precipitation over a catchment area which is associated with important hydroelectric and irrigation works. A description of the experiment is given. It was concluded that the second year's operation of the experiment proceeded satisfactorily: the use of a second aircraft with fewer operational limitations resulted in an increase in the seeding time. Precipitation figures were again consistent with the hypothesis that seeding caused precipitation increases. N.E.A.

N65-26455# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, SNOWY MOUNTAINS Annual Report, 1957
E. J. Smith, E. E. Adderley, F. D. Bethwaite, and J. A. Warburton Sep. 1964 81 p

This is the third of a series of reports on a cloud seeding experiment that took place during the five years 1955 to 1959 inclusive, in the Snowy Mountains of South Eastern Australia. The clouds were seeded with silver iodide smoke released from an aircraft and efforts were made to determine whether this procedure could produce an economically significant increase in precipitation over a catchment area which is associated with important hydroelectric and irrigational works. A description of the experiment is given. It was concluded that from the operation point of view, 1957, although dry, was a successful year. There were fewer limitations on the aircraft's flying than in previous years and a higher percentage of the seeding opportunities were used. Precipitation figures for the three years 1955 to 1957 inclusive were consistent with seeding having produced precipitation increases in both the Target and Seeded Areas, but the third year's figures contributed less than the previous two. N.E.A.

N65-26456# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, SNOWY MOUNTAINS Annual Report, 1958
E. J. Smith, E. E. Adderley, F. D. Bethwaite, and J. A. Warburton Sep. 1964 104 p

This is the fourth of a series of reports on a cloud seeding experiment that took place during the five years 1955 to 1959 inclusive, in the Snowy Mountains of South Eastern Australia. The clouds were seeded with silver iodide smoke released from an aircraft and efforts were made to determine whether this procedure could produce an economically significant increase in precipitation over a catchment area which is associated with important hydroelectric and irrigation works. A description of the experiment is given. It was concluded from the operational viewpoint, 1958 was a successful year. Precipitation figures for this year were consistent with seeding having produced small increases in the Target and Seeded Areas. The accumulated precipitation data from the beginning of the experiment in 1955 were also consistent with seeding having increased the precipitation in both Target and Seeded Areas over the four year period. N.E.A.

N65-26457# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, NEW ENGLAND Annual Report, 1963
E. J. Smith, E. E. Adderley, F. D. Bethwaite, and J. A. Warburton Sep. 1964 68 p

A cloud seeding experiment has been conducted in New England, New South Wales, Australia, to determine the amount by which seeding clouds with silver iodide smoke released from an aircraft can increase precipitation in this area. A brief description of the experiment is given together with a report of the sixth year's operation. It was concluded that the sixth year's operation of the experiment was satisfactorily concluded. The rainfall figures for this year are consistent with cloud seeding causing a decrease in rainfall. However, the figures for the whole six year's operation are consistent with a small increase in precipitation. N.E.A.

N65-26458# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, SNOWY MOUNTAINS Annual Report, 1959
E. J. Smith, E. E. Adderley, F. D. Bethwaite, and J. A. Warburton Sep. 1964 108 p ref

This is the fifth and final of a series of reports on a cloud seeding experiment that took place during the five years 1955 to 1959 inclusive, in the Snowy Mountains of southeastern Australia. The clouds were seeded with silver iodide smoke released from an aircraft and efforts were made to determine whether this procedure could produce an economically significant increase in precipitation over a catchment area which is associated with important hydroelectric and irrigation works. A description of the experiment is given. Diagrams and tables derived from the accumulated five year's precipitation data are included. It was concluded that the operational flying aspect of the experiment in 1959 was very successful. The total precipitation for the operational period was much less than average, associated with unusual synoptic situations. The precipitation figures for 1959 are consistent with seeding having produced very little change in the target area and seeded area precipitations. The accumulated precipitation data for the five years of the experiment 1955 to 1959 inclusive were consistent with seeding having increased the precipitation in both the target and seeded areas. N.E.A.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-25634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group
INTEGRATION AND EVALUATION OF THE PHASE I NAVIGATIONAL CAPABILITY FOR PROGRAM 665A, UTILIZING THE AN/ASN-24V(MOD) DIGITAL COMPUTER Technical Report, Jun. 1963–Sep. 1964
Emile H. Riev Jan. 1965 101 p
(SEG-TR-65-1; AD-613941)

Several changes to the basic aircraft's (JKC-135A) navigational capability include the addition of a star-tracking capability, updating existing navigational subsystems, and the installation of a high-speed digital computer, the AN/ASN-24V(MOD). The upgrading resulted in the maximum accuracy that could be achieved within the time and dollar limitations existing at the start of Program 665A. Flight test results have indicated an upgrading of overall navigational accuracy from the 2.0% to 3.0% range expected from a standard JKC-135A navigational system. To date, the accuracy measured is ±0.64% (percentage ratio of distance from desired flight path to length of flight leg, measured at end of leg) utilizing standard navigational procedures without position fixing. The overall navigational accuracy can be enhanced further by utilizing the system's automatic and successive fixing capabilities. Total error, therefore, can be greatly reduced from ±0.64 percent, depending upon the type and coverage of navigational aids inputs for the fixing modes of operation of the "665A Navigational System." Author

N65-26112# General Motors Corp., Milwaukee, Wis. IMU Gimbal Group
INERTIAL GUIDANCE SYSTEM, WEAPON SYSTEM 107A-2. TITAN II MISSILE GUIDANCE SET, IMU AND MGC GUIDANCE CORROSION PROOFING
Thomas C. O'Connell 3 Aug. 1964 234 p refs
(Contract AF 04(694)-177)
(EP64-241; AD-460981)

Nonpolar coatings that cure only by the evaporation of a solvent are softened by exposure to N_2O_4. This softening allows N_2O_4 permeation and substrate attack. Two coatings were shown to withstand exposure to N_2O_4 fumes for 16 hrs at both high and low humidity levels; however, high-temperature curing is required for both coatings. Several air-dry coatings were cured at low-temperatures and exhibited good compatibility with N_2O_4; however, these coatings softened during exposure to N_2O_4, and their value as a barrier coating over magnesium was lost. Also, anhydrous N_2O_4 fumes soften organic films and cause substrate attack much more rapidly than when moisture is present. Successful resistance of an organic coating to N_2O_4 is dependent upon a minimal coating thickness. In heat exchanger tests, no apparent degradation was noted in the heat exchange between the hot side and cold side after operating with dust-contaminated air. The net heat exchange increased as the test with dust-contaminated air progressed. The amount of dust introduced into the cold air inlet stream was equivalent to operating the heat exchanger for three years at a concentrations of 0.04 mg/lb air. E.E.B.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-25645# Atomic Energy Establishment, Winfrith (England).
A METHOD FOR COMPARISON OF EXPERIMENTAL AND THEORETICAL DIFFERENTIAL NEUTRON SPECTRA IN THE ZENITH REACTOR
D. L. Reed and C. R. Symons Jan. 1965 34 p refs
(AEEW-M-453) HMSO: 4s 6d

A method of calculation is given which assists the analyses of chopper measurements of spectra from ZENITH, and enables complex multigroup theoretical calculations of the spectra to be put into a form which may be compared with an experiment. In addition, the theory of the cutoff function was extended to give analytical expressions which take into account the effects of subcollimators, off center slits, and of a rotor made of a material partially transparent to neutrons. The theoretical cutoff function suggested shows good agreement with experiment. Author

N65-25726# United Kingdom Atomic Energy Authority, Risley (England).
FURTHER ELASTIC SOLUTIONS TO THE PROBLEM OF THE RESTRAINED BOWING OF A NUCLEAR FUEL ELEMENT
W. N. Miller 1965 31 p ref
(TRG-863(S)) HMSO: 4s 6d

The series of elastic solutions are extended to the restrained bowing of a nuclear fuel element. Special attention is given to a fuel element which is simply supported at one end and encastré at the other; bowing due to the combined action of a uniform transverse temperature gradient; and applied mechanical loads; with the bowing being either completely or partially restrained by intermediate grids placed at points on the fuel element longitudinal axis. Author

N65-25844# California Univ., Berkeley. Lawrence Radiation Lab.
RECONDITIONING OF PLASTIC-COATED FUEL ELEMENTS
Donald Freitas May 1965 15 p
(Contract W-7405-ENG-48)
(UCRL-14174) CFSTI: $1.00

Worn plastic coatings on oralloy foil fuel elements are replaced to extend the useful life of the fuel elements. The process involves removal of the old plastic with acetone in an ultrasonic vibrating tank, cleaning with alcohol, and silk screening the new plastic on the fuel elements. The procedure meets all requirements of safety, accountability, security, precision, and repeatability. Author

N65-25878# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
RESEARCH ON GRAPHITE Annual Report, Apr. 1, 1963–Mar. 31, 1964

R. J. Price and J. L. White Washington, AEC, Mar. 1965 100 p refs
(Contract AT(04-3)-167)
(GA-5033) CFSTI: $4.00

A research program is presented on the investigation of the structural behavior and improvement of graphitic materials for use in high temperature reactor systems. Microstructure studies, aimed at the characterization of graphitic materials, include a review of conventional metallographic methods, a quantitative definition of preferred orientation by diffraction methods, and investigations of crystal defects by replication and transmission electron microscopy. Chemical and metallurgical techniques for modifying graphitic microstructure were explored with emphasis on the hot working of graphite and graphite–carbide materials, and recrystallization by liquid metals. The relation of microstructure to physical properties of graphitic materials were investigated and include relations between preferred orientation and directional properties such as thermal expansion and dimensional changes under neutron irradiation. Deformation mechanisms at high temperatures were also examined. R.N.A.

N65-25908# Naval Research Lab., Washington, D. C. Reactor Materials Branch
IN-REACTOR FATIGUE TESTS OF A302-B STEEL REPRESENTING THE ELK RIVER REACTOR PRESSURE VESSEL
J. R. Hawthorne and L. E. Steele 15 Feb. 1965 16 p ref
(Contract AT(11-1)-1369)
(NRL-Memo-1596)

Dynamic low cycle fatigue tests of specimens from a 3 inch thick A302-B plate, representative of the Elk River Reactor pressure vessel, have been performed in-reactor at 550° F. Simultaneous testing of 15 sheet-type specimens, representing 5 average strain amplitudes, in reverse bending was accomplished. Total neutron dosage received by individual specimen at failure ranged from 7.6 to 8.8 × 10^{18} n/cm^2 (>1 Mev), as determined from iron and titanium dosimeter wires. Data derived from in-reactor and out-of-reactor tests did not reveal an effect of irradiation on fatigue properties. Author

N65-25927# Los Alamos Scientific Lab., N. Mex.
POSSIBLE REMOTE MAINTENANCE AND REPAIRS ON REACTORS AT NRDS
W. Charles Wofford May 1965 9 p
(LA-3242-MS) CFSTI: $1.00

Component malfunctions and failures on Kiwi series reactors cannot presently be repaired or replaced remotely after reactor start up at the test cells. Possible methods to correct such malfunctions on some components which might alter or abort a reactor test are described. The use of shielded vehicles for repairs or observations and past incidents of component failure and hydrogen leaks are mentioned. Redesign of certain existing reactor/test car components would be required, and the state of the art in remote handling would have to be expanded. A stockpile of spare reactor/test car components would be required for a reactor maintenance program. Author

N65-25932# United Kingdom Atomic Energy Authority, London (England). Authority Health and Safety Branch
THE SIGNIFICANCE OF RECENT DEVELOPMENTS IN FRACTURE MECHANICS IN GREAT BRITAIN IN RELATION TO THE SAFETY OF REACTOR PRESSURE VESSELS
W. H. Irvine 1965 13 p refs Presented at the ASTM Meeting, Chicago, Jun. 1964
(AHSB-S-R-81)

Theoretical and experimental evidence has in the past suggested that fast fracture in plated structures is controlled by structural behaviour and material properties. Tests to failure on 5 ft diameter, 14 ft long cylindrical steel pressure vessels containing 6 to 24 in. long slits confirm that for constant load conditions, such as exist in a pneumatic test, crack arrest does not occur. Under conditions which are nearer to the constant strain case, such as exist in a hydraulic test, the extent of crack propagation is controlled by fracture toughness and total energy available. A correlation of the form fg^3l^2 = function of (ϕ, f_y, f_u) exists between the critical parameters, crack length l, gross stress f_g, charpy energy absorption ϕ, yield stress f_y, and ultimate tensile stress f_u. This suggests that the critical condition is affected by the path along which instability is approached. Since energy availability controls fracture appearance through plastic zone size, strain rate, and crack speed, cleavage and shear fracture may exist side by side at the same temperature. Interpretation of service and test failures of steel structures should be based on an analysis of factors such as load history, stress level, flaw size, and charpy value, rather than on a fracture appearance temperature approach. The safety implications of these effects in relation to proof testing, annealing out of irradiation damage and material monitoring are discussed. Author

N65-25933# United Kingdom Atomic Energy Authority, London (England). Authority Health and Safety Branch
AN INVESTIGATION INTO THE TEMPERATURE VARIATIONS FOLLOWING A SINGLE CHANNEL FIRE IN AN OPERATING CALDER REACTOR USING 'DEMON'—A TWO-DIMENSIONAL MULTIPLANE COMPUTER PROGRAM
G. E. Betteridge and W. J. Wall 1965 33 p refs
(AHSB-S-R-82) HMSO: 4s

Application of a computer program, in which a comprehensive two-dimensional representation in several axially spaced planes is used to investigate the flow of heat from a single channel fire to the surrounding channels in the core of any square-pitched Stage 1 reactor, is described. Wigner energy is released from the intervening graphite moderator, under the influence of simple annealing kinetics, based on a constant activation energy. This method has been compared with the simpler concept of reduced specific heats. The results which have been obtained show that a single channel fire in an operating Calder reactor should not spread to ignite the magnox in normal surrounding channels even when the graphite energy storage is much greater than that predicted on present theories for the projected 20 year life of this reactor. Some limitations of the reduced specific heat method are also demonstrated. Author

N65-26042# Los Alamos Scientific Lab., N. Mex.
ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report, Period Ending Apr. 30, 1965
28 May 1965 51 p refs
(Contract W-7405-ENG-36)
(LA-3316-MS) CFSTI: $3.00

In this report on advanced reactor technology plutonium reactors and reactor fuels are discussed. The supporting research and developments related to plutonium reactors are reported. Other areas discussed are magneto-hydrodynamics, plasma thermocouple, and heat pipes. N.E.A.

N65-26043# Reactive Metals, Inc., Ashtabula, Ohio.
AN EVALUATION OF DYNAPAK (HERF) EXTRUDED URANIUM TUBES
Q. C. Carloni and L. Robins 9 Apr. 1965 79 p refs
(Contract AT(30-1)-1405)
(RMI-2)

Two experiments were performed to evaluate the Dynapak machine as a production tool for the extrusion of I&E "O" size double length uranium tubing. In the first experiment 38 billets were extruded and dimensional, structural, quality, and outer diameter machining and tooling evaluations were performed. In the second experiment 5 billets were extruded to investigate warpage encountered in the first experiment. A statistical dimensional analysis showed that the mean extruded tube length decreased during the period of the 38 extrusions, the mean depth of rear and defect increased as the mean tube length decreased, the good metal yield is affected by tube length and depth of rear end defect, the degree of tube warpage increased steadily from first to fourth day, close inner diameter tolerance control was exhibited, and a decrease in tube eccentricity was observed as the extrusions progressed. Thermal expansion coefficient and X-ray data revealed circumferential variations in thermal expansion behavior and grain orientation. Beta heat treatments showed the existence of thermal gradients in the extruded tube causing it to act as a bimetallic strip.
R.N.A.

N65-26148# Associated Universities, Inc., New York, N. Y.
NUCLEAR ENGINEERING DEPARTMENT ANNUAL REPORT
Warren E. Winsche and F. T. Miles 31 Dec. 1964 214 p
(BNL-900(S-67)) CFSTI: $6.00

Progress is reported from the Divisions of Reactor Physics, Chemistry and Chemical Engineering, Radiation, Hot Laboratory, Metallurgy, and Engineering. Among the research investigations reported was the experimental program on U^{233} fuels. A complete series of eight lattice configurations of the 3% enriched $U^{233}O_2$-ThO_2 fuel rods in clean, water-moderated systems was investigated and a second series of measurements on boric acid-poisoned water lattices was completed at water-to-fuel volume ratios ranging from 3:1 to 6.8:1. Also, the handling of U^{233} fuel rods required the design and construction of semiremote handling facilities and equipment. These operated satisfactorily and the gamma activity from U^{233} daughter products presented no serious difficulties. Further, Hg corrosion studies showed that pretreatment of ferrite steels or Co-based alloys with Hg containing Ti or Zr prior to corrosion testing with pure Hg does not eliminate corrosion. Methods were developed for analyzing oxygen and carbon in sodium, for detecting ppb levels of cesium and tantalum in Hg, and for detecting 0.1 ppm levels of boron in blood.
E.E.B.

N65-26150# Los Alamos Scientific Lab., N. Mex.
PROCEEDINGS OF AN ADVANCED NUCLEAR PROPULSION SYMPOSIUM
Ralph S. Cooper (comp.) 1 Jun. 1965 384 p refs
(Contract W-7405-ENG-36)
(LA-3229-MS) CFSTI: $7.00

Symposium papers are presented on concepts beyond the solid core heat exchanges using nuclear energy to produce a high thrust propulsion system. For individual titles see N65-26151–N65-26170.

N65-26152 Brookhaven National Lab., Upton, N. Y. Nuclear Engineering Dept.
BNL FLUIDIZED BED STUDIES
L. P. Hatch *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 48–62 (See N65-26150 15-22) CFSTI: $7.00

The rotating fluidized bed reactor concept offers a major advantage in the large amount of surface area presented for heat transfer from the solid fuel to the gas coolant. The system design features the fuel in the form of a bed of solid particles held in suspension in the flowing gas coolant and confined to the reactor core by virtue of centrifugal force. Representations of such fluidized beds are presented, and the operation of these fluidized beds are discussed in detail. A unit advanced design with a bed diameter of 10 inches and 1-inch length, which has been operated at 2000 g's is also given. Further, a line-drawing design of a new unit of about the same dimensions which is intended for operation up to 10000 g's is shown.
E.E.B.

N65-26153 Boeing Co., Seattle, Wash.
FLASH X-RAY ANALYSIS OF FLUIDIZED BEDS
Jacob B. Romero *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 63–82 refs (See N65-26150 15-22) CFSTI: $7.00

Flash X-ray experiments and the analysis of fluidized beds are presented. The apparatus used was a high-speed, X-ray unit, which produces a tremendous dose of radiation in a matter of tenths of microseconds. Thus, it essentially stops all motion which allows the examination of the conditions within the fluidized bed at any time. Such an analysis shows that the fluidized bed consists of distinct dilute and dense phases. The flow through the dilute phase is in the form of gas bubbles, whose size and frequencies increase with flowrate and whose rise velocities follow closely the theory of Davies and Taylor. Also, the constancy of dense phase bed density with flowrate provides a good evidence on the validity of the two-phase theory of fluidization. Also the observations of bubble sizes, shapes, and velocities strongly suggest a liquid-like nature for the fluidized bed.
E.E.B.

N65-26154 Los Alamos Scientific Lab., N. Mex.
FLUIDIZED BEDS
A. C. Juveland, H. P. Deinken, and J. E. Dougherty *In its* Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 83–85 refs (See N65-26150 15-22) CFSTI: $7.00

Heat transfer, evaporation losses at high temperature, and mechanical properties of fluidized beds are discussed. Indications are that no special effort will be required to increase heat transfer, since even though the heat transfer coefficient is low, the total particle surface area is extremely large even in a shallow bed. The material losses were measured in a resistance heated high-temperature furnace. The heating element, which also served as the fluidized bed container, consisted of a graphite tube with a centrally located perforated graphite disc. Both the tube and the disc were coated with NbC. Solid solutions of ZrC–UC were used for the particle material. Losses of Zr and U are considered. Also, both rotating, multigravity systems and normal gravity systems were used to study the mechanical properties of fluidized beds. The rotating systems tended to become more unstable as the number of g's were increased. Schemes for achieving a stable bed are included.
E.E.B.

N65-26155 Los Alamos Scientific Lab., N. Mex.
FLUIDIZED BEDS
Ralph Cooper *In its* Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 86–88 refs (See N65-26150 15-22) CFSTI: $7.00

Specific impulse, vaporization losses, criticality, power profiles, flow rates, stability, and heat transfer are discussed for the fluidized bed reactor. The fluidized bed should be able to give significantly higher specific impulse than solid core reactors. The greatest uncertainty lies in the area of the stability of the flow. Recently it was shown that all fluidized beds are unstable in the sense that fluctuations in the bed density will propagate upward with increasing amplitude. In deep beds, bubbles will be formed; but, generally the rest of the bed will be maintained in a fluidized state. Thus, even though the bed may be unstable it can be possible to have adequate heat transfer throughout the bed to prevent local overheating and meltdown of the fuel. Also, large area shallow beds may possess other modes of instability, such as channeling, which could make the concept unfeasible. It is therefore necessary to examine the flow under appropriate conditions. E.E.B.

N65-26156 Princeton Univ., N. J.
THE LIQUID-CORE NUCLEAR ROCKET
Jerry Grey *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 90–110 refs (See N65-26150 15-22) CFSTI: $7.00

The specific impulse, engine thrust-to-weight ratio, heat transfer, bubble flow, structural design, and mechanical operation of the multi-element liquid-core reactor system are discussed. The specific impulse of the liquid-core nuclear rocket is limited to the range of 1500 to 1550 seconds, assuming that no new material technology is discovered to extend this range. Its limitation is due primarily to the vapor pressure of those fissionable materials and moderators which are available. The engine thrust-to-weight ratio attainable with the multielement liquid-core can be approximately unity for a fuel-element pressure of about 100 atm. Extending the fuel-element pressure to 1000 atm provides improvement by a factor of 10. The principal feasibility areas are those of bubble flow and heat transfer in liquid annuli at high gravities and the determination of vapor pressures and metallurgy of the various phase mixtures of refractory materials suitable for reactor cores. E.E.B.

N65-26157 General Electric Co., Santa Barbara, Calif.
EXPERIMENTAL WORK IN RELATION TO THE GLOW-PLUG CONCEPT
J. W. Mc Kee *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 110–115 refs (See N65-26150 15-22) CFSTI: $7.00

A central problem in the application of gaseous fission reactors to space vehicle propulsion is to reduce the amount of fissionable material which leaves the system with the propellant. The basic idea of the glow-plug propulsion system is to partition the fissionable material from the propellant by a transparent wall which is regeneratively cooled. In the particular configuration discussed, an elongated toroid forms the fuel container. Regenerative cooling of nozzle, reflector–moderator, and container is acccomplished by propellant before it is seeded to increase opacity and heated by radiative transfer. The experimental exploration of the concept is concerned with the following: (1) measurements of transparency of container materials during irradiation; (2) chemical compatibility of container materials with potential fuels; and (3) employment of a graphite pulsed reactor to obtain radiant emission from gaseous fissionable material. Experimental work on these three problems is described. E.E.B.

N65-26158 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THE TRANSPARENT PARTITION GASEOUS CORE REACTOR CONCEPT
D. E. Knapp *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 116–136 refs (See N65-26150 15-22) CFSTI: $7.00

An initial approach to the transparent partition reactor concept is illustrated. Hydrogen from a propellant tank is heated in three steps: (1) as it flows through the cooling passage in the double-walled tubes containing the fuel; (2) as it cools the reflector–moderator; and (3) as it passes outside the fueled transparent tubes. Between the second and third steps the propellant must be seeded to absorb thermal radiation. The basic question of the ability of transparent materials to function in the manner required by the concept is discussed in detail. The properties of transparent materials which are important are their thermal conductivity, thermal stress characteristics, optical absorption, and chemical stability. Each of these properties are examined for candidate materials. Also, the experiments which provide critical data on radiation damage for the transparent partition concept are summarized. The major performance limit seems to be the low engine thrust-to-weight ratio resulting from convective heating on the outer tube surface. E.E.B.

N65-26159 United Aircraft Corp., East Hartford, Conn. Research Labs.
WORK ON NUCLEAR LIGHT BULB AT UAC RESEARCH LABORATORIES
George H. Mc Lafferty *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 137–147 (See N65-26150 15-22) CFSTI: $7.00

The concept of the nuclear light bulb, also known as the glow-plug, is illustrated. The configuration is symmetrical about a center line. Gaseous nuclear fuel at high-temperature radiates thermal energy to seeded hydrogen passing axially along a passage on the outer side of the transparent wall. The transparent wall is composed of a double layer of transparent material with a coolant, possibly helium, passing between the two layers and with helium injected inside the wall to keep the gaseous nuclear fuel away from the wall. The main problem in a nuclear light bulb which is different from other gaseous nuclear rocket concepts is the problem of annealing the radiation-induced coloration in the transparent wall material. This problem is discussed in detail. E.E.B.

N65-26160 Princeton Univ., N. J.
HIGH-TEMPERATURE GAS INTERACTIONS
Jerry Grey *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 149–176 refs (See N65-26150 15-22) CFSTI: $7.00

The use of mass injection through a porous wall as a cooling technique for axisymmetric nozzles is investigated. The effect of homogeneous mass injection on the heat transfer in a turbulent, compressible boundary layer is analyzed using an integral momentum approach. Approximate formulations of the gaseous thermal radiative and recombination energy contributions are included in the analysis. Coolant requirements are determined for a conical nozzle associated with a million pound thrust gas core system operating at a 300 atmosphere chamber pressure. Hydrogen is assumed to be used for the propellant and coolant. Chamber temperatures range from 7500° to 20,000° R, and wall temperatures range from 2000 to 3000° R. The degradation of specific impulse, which is a result of expelling the coolant at a lower total temperature than that in the chamber, is found to be as high as 7% at 20,000° R for a wall temperature of 3000° R. Author

N65-26161 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COAXIAL FLOW GASEOUS NUCLEAR REACTOR CONCEPT
Frank E. Rom *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 177–179 (See N65-26150 15-22) CFSTI: $7.00

In the coaxial flow gaseous nuclear reactor concept, separate streams of uranium and hydrogen are introduced into a reflector moderated cavity. The hydrogen flows coaxially and concentric with the uranium core. The uranium flows at a lower velocity than the hydrogen to maintain an acceptable ratio of uranium-to-hydrogen mass flow ratio. The resulting mixture of hydrogen and uranium is exhausted through a nozzle to produce thrust. The hydrogen is heated by thermal radiation from the fissioning central zone of uranium and contains seeding material which renders it opaque to thermal radiation from the core. In this concept the most important factor is the number of uranium atoms that are in the core at any given time. E.E.B.

N65-26162 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COAXIAL FLOW RESEARCH STUDIES
Robert G. Ragsdale *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 180–207 (See N65-26150 15-22) CFSTI: $7.00

Fluid mechanics, heat transfer, and nucleonics of coaxial flow systems are discussed. Also, some exploratory calculations of the performance characteristics of a coaxial flow nuclear engine are given which are based on the current information on turbulent mixing, radiation heat transfer, and reactor criticality. The calculations illustrate the following characteristics of a gaseous fueled nuclear engine operating at a 1500 sec specific impulse: (1) Reactor moderator, reflector, and structural materials are unfueled and can be operated at about 3200° R. (2) Hydrogen enters the reactor cavity at 3000° R and is exhausted at about 8700° R. (3) Reactor criticality can be maintained by a pressure of 500 to 800 atm. (4) The fuel loss rate can be maintained sufficiently low so that the cost is less than that of the H_2 propellant without appreciable degradation of specific impulse. (5) Engine thrust-to-weight ratios greater than one are possible with no severe penalty with increased thrust levels. E.E.B.

N65-26163 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COAXIAL FLOW RADIATION HEAT TRANSFER ANALYSIS
Albert F. Kascak *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 208–221 (See N65-26150 15-22) CFSTI: $7.00

A heat transfer analysis is presented for axial flow in a coaxial flow system. The method of solution is to assume a temperature distribution, evaluate the radiation integrals as a function of position, and then solve the resultant nonlinear differential equation for a new temperature distribution. The process is continued until the temperature distribution does not change by some specified amount. Also, the general technique for evaluating the radiation integrals are given. The integrals are first evaluated in the radial direction and terminated at the wall or when the contribution to the total radiation becomes negligible. This permits the calculation of the optical distance between the field and the source point and its contribution almost at the same time. The surface term is then added to the total. The angular integration was weighted in specific directions. The weighting function was chosen so that the direction with high heat flux could be sampled with smaller increments. For this case, the core direction is weighted the heaviest. E.E.B.

N65-26164 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GAS CORE REACTORS
Henry J. Stumpf *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 222–236 ref (See N65-26150 15-22) CFSTI: $7.00

The two major problems confronting the gaseous-fuel reactor, fuel containment and heat deposition in the solid regions, are discussed. As a candidate to propel future generation rockets, the gaseous-fuel reactor may outperform solid fuel propulsion reactors by a factor of two. A major shortcoming is the lack of experimental data on the fluid dynamics and radiative properties of the complex gaseous mixtures that occur in the vortex tube. These systems hold promise for high-performance for missions to nearby planets although their performance cannot equal that of the nuclear electric system for missions to the far planets. E.E.B.

N65-26168 Douglas Aircraft Co., Inc., Santa Monica, Calif.
CRITICALITY OF GAS CORE REACTORS
R. J. Holl *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 315–343 (See N65-26150 15-22) CFSTI: $7.00

Nuclear calculations are presented for a generalized concept typical of the gas core reactor. Methods are described for the survey of fuel materials, reflector materials, core dimensions, and reflector thicknesses. The critical mass in kilograms of U^{235} vs core size for graphite and beryllium oxide reflectors with variable reflector thicknesses at 2800° K is given. Also, the critical mass for spherical cavity reactors vs reflector temperature, the effect of reduced fuel radius for variable reflector thicknesses, the effect of void fraction on criticality for a cylindrical cavity reactor, and the effect of exhaust nozzle parameters on criticality for a cylindrical cavity reactor are displayed, and a composite of these effects is shown. The fuel radius is reduced by a factor of two, there is a 10% void fraction in the reflector, and a nozzle hole which corresponds to the throat of a nozzle with 1 million pounds thrust. These represent a minimum effect on criticality. E.E.B.

N65-26169 Los Alamos Scientific Lab., N. Mex.
CAVITY REACTOR
George A. Jarvis *In its* Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 344–361 (See N65-26150 15-22) CFSTI: $7.00

Critical mass determinations were made for four different fuel distributions. Most significant of the results obtained was the rapid rise in the critical mass with decreasing fuel zone radius. Also, an experiment was conducted to evaluate the effect of introducing a nozzle in one end of the cavity reactor. For this purpose, several empty cylindrical tanks, ranging from 4 to 10 inches were placed in the lower end reflector, and the critical mass for each configuration determined. The fuel was in the form of 3-mil uranium foil lining the surface of the cavity. The fuel penalty is shown as a function of orifice diameter. A series of critical mass determinations were also made with the D_2O reflected cavity reactor mockup. Uranium loaded graphite elements were distributed within four different radii in uniform cylindrical shells. A summary of the critical mass as a function of fuel zone radius is shown. Further, the reactivity change as a function of the reflector D_2O temperature was determined and the loading geometries displayed. E.E.B.

N65-26170 Los Alamos Scientific Lab., N. Mex.
CRITICALITY
C. B. Mills *In its* Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 362–376 (See N65-26150 15-22) CFSTI: $7.00

The neutronics, criticality, heat balance, gas density, and geometry of gaseous reactors are discussed. Critical concentrations of U^{235} are given for reflector moderated reactors, core moderated homogeneous reactors, and reflector moderated gaseous reactors. The development of a gaseous reactor with a homogeneous geometry is indicated to be easily feasible. The radius of a fissionable gas in a cylindrical cell is shown not to affect criticality above area ratios of fuel to cavity of about 0.01. The general characteristics of gaseous reactors include simplicity and sensitivity to any neutron sink. The one-cavity reactor will tolerate relatively small fuel radii. Low fuel atomic densities are consistent with large reactor sizes, with both types having roughly the same values of fuel concentration near 300-cm radius. Neither type is clearly better with regard to reactor neutronics. E.E.B.

N65-26340# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM: AGN-GAM, AN IBM 7090 CODE TO CALCULATE SPECTRA AND MULTIGROUP CONSTANTS
T. P. Wilcox and S. T. Perkins Apr. 1965 145 p refs
(Contract AT(10-1)-880)
(AGN-TM-407) CFSTI: $3.00

The AGN-GAM (IBM 7090) code is discussed together with the subroutines for writing and revising the library tapes. The code solves either the P-1 or B-1 equations for 75 quarter lethargy energy groups from 10 Mev to 0.07 ev to determine the slowing down fluxes and currents in a reactor core. Provision is also made to solve P-1 equations to determine these quantities in a reflector region. Broad group constants, weighted by the flux (or current) quantities, are then derived for use in diffusion, isotropic transport or anisotropic transport calculations. The method of Adler, Hinman and Nordheim is used to calculate resonance absorption and fission cross sections. Self-shielding factors can be included in the computations. The output cross section data can be punched directly into IBM cards for use in any of several nuclear codes. Author

N65-26341# Atomics International, Canoga Park, Calif.
HALLAM NUCLEAR POWER FACILITY REACTOR OPERATIONS ANALYSIS PROGRAM Semiannual Progress Report No. 4, 29 Feb.–30 Sep. 1964
S. Berger, D. K. Darley, W. S. DeBear, D. N. Glass, O. G. Jenkins, Jr. et al 15 May 1965 162 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10743) CFSTI: $5.00

A review and analysis of the reactor operations from March 1, through September 30, 1964 is presented that depicts the electrical energy generation history, shows the periods of major shutdowns, and includes a summary of the major operation statistics. During this period the power facility generated 72,547,000 kwh of electrical energy. Analysis of nine moderator element failures in the outer portion of the core seemed to indicate the location as a function of failure. Some tensile, hardness, and fatigue tests of 304 stainless steel samples were performed to evaluate their application as moderator can material. A systems and components analysis of the main heat transfer system, the sodium service system, the auxiliary systems, the radiation shielding during handling of the fuel elements, and the plant control system is included. An equipment malfunction history file was set up to make maintenance and modification information easily available. G.G.

N65-26351# Atomics International, Canoga Park, Calif.
SNAP 10A FSEM-3 AGENA COMPATIBILITY TEST
M. Teresa 15 Jun. 1965 43 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-11129) CFSTI: $2.00

This report summarizes the results of SNAP 10A/Agena developmental testing and final vehicle systems tests. Developmental testing was performed with the SNAP 10A FSEM-3 payload electrical simulator and an Agena Functional Mockup. FSEM-3 was utilized during vehicle systems testing prior to shipment of the Agena to the launch site. Author

N65-26430# Max-Planck-Institut für Biophysik, Frankfurt am Main (West Germany).
DIRECT CONVERSION OF NUCLEAR ENERGY INTO ELECTRIC ENERGY. SERIES C: BIBLIOGRAPHIES
AED Information Service, 1965 94 p refs Comp. by Battelle Inst., Frankfurt
(AED-C-15-05)

A bibliography is presented on direct nuclear energy conversion into electric energy. R.N.A.

N65-26439# AiResearch Mfg. Co., Phoenix, Ariz.
[SNAP 50/SPUR NUCLEAR MECHANICAL POWER UNIT PROGRAM] Quarterly Technical Progress Report, Period Ending Mar. 31, 1965
17 Apr. 1965
(Contracts AF 33(615)-2289; AF 33(615)-1551)
(APS-5152-R2; AD-461733)

Development work on the power conversion components for the system pertained to studies on the mechanical properties of TZM; tests and analyses on liquid-potassium bearings and seals; turbomachinery tests and analysis; fabrication and testing of nonrefractory multitube potassium boilers with supporting test and analysis; condenser design and analysis; control system analysis; and an auxiliary power supply analysis. G.G.

N65-26587# Atomics International, Canoga Park, Calif.
HYDRAULIC STUDIES OF THE LSGR PROCESS CHANNEL
J. H. Brindley 15 Jun. 1965 48 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11123) CFSTI: $2.00

Hydraulic tests were performed with water on a full-scale mockup of the Large Sodium Graphite Reactor (LSGR) process channel consisting of a process tube containing an 18-rod cluster of fuel rods, "cookie cutter" spacers at 1-ft intervals, and a variable orifice assembly. Reported are pressure-loss flow-rate characteristics of entrance and exit components; fuel rod spacers; the fuel bundle; and a unique variable flow-control device. Principles of dimensional similitude were used to convert water test data to those of LSGR coolant conditions. The sodium flow rate through the process channel at the design core pressure drop of 21.0 psi can be controlled from 45.5 to 13.4 lb/sec with the variable orifice. Radial velocity-profile studies in the fuel bundle demonstrated that $V_{max}/V_{avg} = 1.33$. Fuel rod spacer drag coefficients, based on de Stordeur's correlation, were found to be constant at 1.5 over a Reynolds number range of 1,000 to 20,000. Author

N65-26592# Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM Semiannual Progress Report, Period Ending Mar. 31, 1965
D. B. Trauger and G. D. Whitman Jun. 1965 309 p refs
(Contract W-7405-ENG-26)
(ORNL-3807) CFSTI: $7.00

Various facets of a program for an advanced gas-cooled reactor are discussed. Fueled-graphite development continued, and other fuel compositions were investigated. Reactor component systems and materials were tested, and performance analyses were conducted. Heat transfer and fluid flow, the AVR–German pebble-bed reactor, and other advanced reactor systems were also studied. LS.

N65-26595# General Electric Co., Cincinnati, Ohio. Atomic Products Div.
DEVELOPMENT OF NUCLEAR SENSORS Final Report
R. H. Stentz and R. L. Treinen 25 Jun. 1965 52 p
(Contract AT(40-1)-2847)
(GEMP-90) CFSTI: $3.00

This report contains the results of a program to develop advanced nuclear sensors for general use in the nuclear industry for monitoring and controlling high-temperature, high performance reactors. Most of the effort centered on the development of two new types of sensors, the a-c ionization chamber and the charged fragment detector. Various types of alternating current neutron-sensitive ionization chambers were designed and tested for both ambient and high-temperature operation. Some of these chambers displayed unique advantages when compared to d-c chambers. Specialized auxiliary electronic equipment was also constructed to facilitate testing of these chambers. A-c chambers and auxiliary electronic units were satisfactorily adapted for use in a power-range regulating-rod control system. The charged-fragment thermal-neutron sensor concept was adequately tested, but reliable operation was only achieved when external power was applied to the sensor. The powered version of the sensor concept offers excellent possibilities for high-temperature and in-core-flux monitoring applications. The concept of utilizing radiative capture of thermal-neutrons to devise an unpowered, fast response thermal-neutron sensor was satisfactorily demonstrated. Unpowered gamma-sensitive sensors were also tested and found to be practical for high gamma flux applications. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-25680# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
EFFECTS OF VACUUM-ULTRAVIOLET ENVIRONMENT ON THE OPTICAL PROPERTIES OF BRIGHT ANODIZED ALUMINUM Technical Report, 1 Jan. 1963–1 Aug. 1964
James H. Weaver Jan. 1965 22 p refs
(AFML-TR-64-355; AD-612774)

The optical properties of the bright anodized aluminum system are only slightly altered by ultraviolet radiation in air, but the combined vacuum-ultraviolet radiation is the most detrimental to the reflectance of bright anodized coatings prepared by the sulfuric acid process. The color centers formed during exposure cause a gradual increase in absorption up to 120 hr exposure. This increase in solar absorption causes the α_s/ϵ ratio to increase to 0.42 after approximately 120 hr exposure; after this change, very little further change is noted, unlike most organic and inorganic coatings. After degradation, coatings with α_s values ranging from 0.18 to 0.35 with a corresponding emittance range of 0.40 to 0.80, depending on the coating thickness, were prepared. Bright anodized aluminum cannot be eliminated from the list of promising materials useful in space as passive temperature control coatings. Author

N65-25690# Oregon Univ., Eugene. Physics Dept.
OBSERVATIONS ON THE SPHERICAL MODEL OF A FERROMAGNET
C. C. Yan and G. H. Wannier [1964] 21 p refs
(Contract Nonr-2771(05))
(TR-5; AD-612678)

A discrepancy between the methods of the grand and the canonical ensemble which arose in the study of the spherical model of a ferromagnet, even for properties of individual spins, is traced to an incorrect order of taking limits. The spin system must be considered first for a small but not vanishing field, and the limit of zero field must only be taken after the limit of an infinite number of particles has been taken. For this case, no discrepancy between the two ensembles arises. A calculation proceeding entirely at zero field cannot be considered as logically admissible; discrepancies arising in this case are thus of no physical consequence. Author

N65-25694# Harvard Univ., Cambridge, Mass. Cruft Lab.
SEMIANNUAL PROGRESS REPORT NO. 68, 1 JANUARY–1 JULY 1964
15 Dec. 1964 58 p refs
(Contracts Nonr-1866(07); Nonr-1866(16); Nonr-1866(28); Nonr-1866(32))
(SAPR-68; AD-612736)

Progress is reported under the headings of *Electron and Solid State Physics; Automatic Control; Communications and Networks;* and *Electromagnetic Radiation*. Abstracts of articles on these subjects are included. Among the investigations was the experimental study of electrically thick antennas. An apparatus for measuring the relative magnitude and phase of the axial distributions of current and charge along thick antennas was designed for an operating frequency of 600 Mc. The supporting structure and the smallest diameter antenna-coaxial line set was built and assembled. Testing and calibration of the radiofrequency components, instruments, and mechanical parts of the system are nearly completed. Antenna tubes of $ka = 0.638$ and $= 0.878$ will complete the set. E.E.B.

N65-25769# Utah State Univ., Logan. Electro-Dynamics Labs.
RESTORATION OF OPTICAL PATTERNS Scientific Report No. 3
C. K. Rushforth 1 Mar. 1965 28 p refs
(Contract AF 19(628)-3825; ARPA Order 450)
(AFCRL-65-181; AD-614272)

The problem of estimating the intensity distribution of an optical pattern which has been distorted by diffraction and noise is treated. Under the assumption that the signal and noise are additive and that they have prescribed means and covariance matrices, the optimum linear estimate of the object distribution is obtained. This estimate is shown to be a linearly-filtered combination of the *a priori* mean and the observed image distribution, with the details of the filtering depending on the prior information, the noise statistics, and the optical imaging system. The performance of the optimum estimation procedure is evaluated for the important special case of large *a priori* uncertainty. Finally, the optimum procedure for processing multiple observations is discussed. It is shown that as the number of observations becomes large, the estimate approaches the true object. Author

N65-25888# Optics Technology, Inc., Palo Alto, Calif.
LONG WAVELENGTH INFRARED FIBER OPTICS Interim Engineering Report, 16 Dec. 1964–15 Feb. 1965
N. S. Kapany and R. J. Simms Mar. 1965 17 p
(Contract AF 33(615)-1952)
(IER-3; AD-612902)

Development work on far infrared transmitting fiber optics is reported. Effort during the third quarter has been concentrated on the following. 1) additional samples of glass were evaluated in fiber draws; 2) techniques were developed to demonstrate the presence of the coating glass on a coated fiber; and 3) transmission profiles and radiation pattern measurements were recorded for two types of coated fibers. The results are included in this report. Furthermore, effort on the development of techniques for fabricating short flexible light pipes was continued and several successful samples have been made using uncoated fibers. Two glass combinations have been used to produce short lengths of good quality coated fibers. Devitrification is still a problem, producing some seeds in long lengths of fiber, but additional draws are scheduled with these glasses in an attempt to minimize this defect. The optical evaluation equipment has proved to be satisfactory for the measurements required and the characteristic curve concept has been demonstrated. Light pipe fabrication techniques have been developed and appear to be satisfactory for the production of short flexible components. Author

N65-25892# Rochester Univ., N. Y. Inst. of Optics
ULTRAVIOLET ABSORPTION OF SOLID DEUTERIUM
Giancarlo Baldini [1964] 6 p refs Presented at the Intern. Comm. for Optics Conf. on Phot. and Spectroscopic Optics, Tokyo and Kyoto, 1–8 Sep. 1964
(Grant AF-AFOSR-236-63)
(AFOSR-65-0443; AD-612638)

The absorption spectrum of deuterium and its electronic and optical properties were investigated, using D_2 films of different estimated thicknesses. For the solid D_2, the absorption constant rises very sharply above 11.2 eV and reaches $\sim 10^6 cm^{-1}$ at 12 eV; a second rise occurs at 12.2 eV, and a broad maximum is reached at $\sim$ 13.2 eV. When Xe and Kr impurities were diluted into the solid D_2, the absorption pattern changed materially, indicating that the impure atoms are more energetic than the free atoms. If the energy from the trapped Xe is expressed mathematically, the effective mass of a conduction electron in solid D_2 can be estimated in the order of 0.2 electron masses. M.W.R.

N65-25916# Pneumodynamics Corp., Grand Rapids, Mich. Instrumentation and Control Operations
APPLIED RESEARCH INVESTIGATION OF ELECTRIC FIELD SOURCES VIA SOLID IONS MATRIX Technical Report, Jul. 1964–Mar. 1965
Robert F. Elder Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1965 19 p
(Contract AF 33(615)-2041)
(AFAPL-TR-65-5; AD-613049)

This report covers the results of a study program involving the generation of a stored electric field, analogous to a permanent magnet field, using dielectric materials bombarded with low energy beta particles. Methods for achieving the volumetric distribution of such particles in solid dielectric material (quartz) were investigated utilizing the VanDeGraff generator principle. The technique utilized combinations of high voltage accelerator and high vacuum systems. Author

N65-25922# Pennsylvania State Univ., University Park. Dept. of Ceramic Technology and Materials Research Lab.
ANISOTROPY AND STRENGTH OF CERAMIC BODIES Progress Report, Oct. 15, 1963–Oct. 15, 1964
W. R. Buessem, H. A. Mc Kinstry, and G. R. Barsch 15 Oct. 1964 61 p refs
(Nonr-656(27))
(PR-9-12; AD-613350)

The effect of elastic and thermal expansion anisotropy on the strength of ceramic materials is being investigated using ceramic bodies prepared from compositions where one of the anisotropy factors is known to be a minimum. The second order elastic constants of solid solution systems are being measured to determine the effect of composition on elastic anisotropy. The third order elastic constants have been successfully measured for fused silica, Ge and MgO. These data are a part of the thesis of E. H. Bogardus. The study of the strength of the grain boundary in bicrystals of MgO is nearing its completion. A theory for calculating the mechanical strength of crystals has been developed which makes use of the experimentally determined second and third order elastic constants. This makes possible a more realistic estimation of the maximum strength attainable. Author

N65-25956# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EFFECTS OF GENERAL RELATIVITY ON INTERPLANETARY TIME-DELAY MEASUREMENTS Technical Report No. 368
I. I. Shapiro 18 Dec. 1964 29 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-590; AD-614232)

The predictions of general relativity regarding interplanetary time-delay measurements are explored in detail. We conclude that a fourth test of the theory is now feasible since the modifications of general relativity introduce an extra delay of about 200 μsec when radar waves are reflected from either Mercury or Venus near superior conjunction. The uses of such measurements to investigate the solar corona, a possible time dependence of the gravitational constant, and the precession of Mercury's perihelion are also discussed. Author

N65-25960# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A METHOD FOR POWER SPECTRUM PARAMETER ESTIMATION
M. J. Levin 10 Feb. 1965 31 p refs *Its* Group Rept.-1965-8
(AD-612796)

An asymptotic analysis is carried out for an approximate method of estimating the parameters of the power spectrum of a zero-mean stationary Gaussian random process from an observed realization of limited duration. Maximum likelihood estimates are obtained with the approximation that the coefficients of the Fourier series expansion of the realization are uncorrelated. This is equivalent to other approximation techniques which assume a periodic covariance function. The dispersion of the estimates is evaluated in terms of a quantity called the differential variance. It is shown that with this quantity as a criterion, the approximate estimates are as good, asymptotically, as the exact maximum likelihood estimates. An approximate expression for the differential variance in terms of the power spectrum is given and it is shown that this expression asymptotically approaches its exact value. These results follow from a general expression, obtained by means of a converse to the Schwarz inequality, which compares the differential variance of the approximate estimates with that of the maximum likelihood estimates. This expression is evaluated for the power spectrum parameter estimation problem in terms

of the covariance matrix of the Fourier coefficients. The asymptotic behavior of these covariances is bounded so that the convergence of the elements of the inverse covariance matrix can be demonstrated. The results on the differential variance of the approximate estimates are then established by matrix methods. Author

N65-25976# Stanford Research Inst., Menlo Park, Calif. Electronics and Radio Sciences Div.
MEASURING THE ELECTRICAL CHARGE AND VELOCITY OF A MOVING PROJECTILE Interim Engineering Report, Jul. 1964–Jan. 1965
Joseph E. Nanevicz and Willard C. Wadsworth Jan. 1965 32 p refs
(Contract AF 33(615)-1934)
(IER-1; AD-612797)

Two different probes were developed for measuring the electrical charge and velocity of a moving charged projectile. The probes were tested using 5/32-inch-diameter steel balls fired from a rifle at roughly 4500 feet per second. The projectiles were frictionally charged to from 50 to 100 μμcoulomb by passing through a 0.0003-inch-thick plastic sheet. Author

N65-26066# CBS Labs., Stamford, Conn.
PERSONNEL COMMUNICATIONS FOR LOCATION, RETRIEVAL AND RESCUE—ACOUSTICS AND MAGNETICS PROJECT REPORT
G. T. Volpe and A. L. Di Mattia Aug. 1964 11 p
(Contract AF 33(615)-1319)
(AD-461001)

A biochemical fuel cell which uses human waste as fuel is discussed. The cell has the disadvantage in that the available power output decreased markedly after withdrawal of about 48 coulombs. The electrical power output decreased from an anodic power density of 1.75 mW per sq ft of electrode surface after 30 coulombs of withdrawal and to 0.2 mW per sq ft after 48 coulombs of flow. The highest anodic potential obtained was 0.8 V. Highest short circuit current was 105 MA and maximum power density was 4.0 mW for each square foot of electrode area. The heating value of feces measured in a bomb calorimeter gave values of 4951 to 4697 cal/g. A description of the delta modulation process for radio transmission is also discussed. E.E.B.

N65-26291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPEED OF SOUND IN TWO-PHASE MEDIA
M. Ye. Deych, G. A. Filippov, and Ye. V. Stekol'shchikov 26 Mar. 1965 13 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 8, 1964 p 33–36
(FTD-TT-64-1030/1+2; AD-614015)

Differences between theoretical calculations and experimental investigations of the speed of sound in two-phase media are presented. A thermodynamic approach is followed because it takes into account phase conversions, but eliminates the effect of amplitude and frequency on the speed of sound. This report considers the vapor phase as an elastic medium, with foreign inclusions affecting elasticity. Dependence of the speed of sound on vapor dryness and on moist vapor is plotted, and compared with the experimental data. Results show that speed of sound calculated by thermodynamic theory has a much lower value than that obtained in experiments. With the rise in degree of moistness, the difference between these speeds increases. In calculating the speed of sound in channels and turbine grids, a formula which does not consider phase transitions during propagation of weak perturbations should be used. It was concluded that an important problem in practical calculations is the determination of form, frequency, and amplitude of perturbation pulses. M.W.R.

N65-26346# Parke Mathematical Labs., Inc., Carlisle, Mass.
TOROIDAL WAVE FUNCTIONS AND THEIR APPLICATION TO THE FREE-FLOODING RING TRANSDUCER Scientific Report No. 2
Charles H. Sherman and N. G. Parke Dec. 1964 62 p refs
(Contract N140(70024)-75686B)
(Rept.-75686B-SR-2)

V. H. Weston has derived solutions of the wave equation in toroidal coordinates which can be used to solve the problem of acoustic radiation from a torus. The wave equation is not separable in toroidal coordinates and special methods are required to obtain solutions. Weston's solutions are not orthogonal functions, which also requires special methods in applying them to radiation problems. However, the special case of a torus of infinitesimally thin cross section can be solved by the usual methods, and in this report this thin torus problem is worked out in detail. The usefulness of this problem as a theoretical model for free-flooding ring transducers is shown by comparison of calculations and measurements. The calculation of toroidal wave functions is discussed, and numerical results are given for those functions which are needed in transducer problems. Author

N65-26511 Library of Congress, Washington, D. C. Aerospace Technology Div.
CALCULATION OF THE ENTROPY OF THE OPTICAL IMAGE AND DEFINITION OF THE EFFECTIVE DIMENSIONS OF DISPERSION PATTERNS
R. A. Krasnovskiy *In its* Quality of the Phot. Image 11 Mar. 1965 p 40–54 refs (See N65-26508 15-14)

Properties of optical images which are transmitted along communications channels are studied theoretically. A relationship is established between the dimensions of a diffusion figure on the one hand, and the assigned number of sight gradations and energy distributions in the diffusion figure on the other. It is shown that an evaluation of image properties can be made on the basis of the computed image entropy or by determining the image entropy density. Two examples show the determination of the effective dimensions of diffusion figures for a certain optical system and for a complex transmission channel. J.M.D.

N65-26525 Library of Congress, Washington, D. C. Aerospace Technology Div.
OPTICS OF THE DEVELOPED TRANSPARENCY. THE LENS EFFECT
Ye. A. Bukatin *In its* Quality of the Phot. Image 11 Mar. 1965 p 166–178 refs (See N65-26508 15-14)

The emulsion layer of a developed photographic image is studied as a lens system. The surface of the gelatin layer of the developed image consists of the surfaces of a multiplicity of spherical, cylindrical, conical, annular and figured positive and negative lenses and prisms. The lens elements have focal lengths from a few hundredths of a millimeter to infinity. When a transparency is used in a projection system such as an enlarger or slide projector, many real and imaginary images of the light source of the system are formed. The images formed by the short focus lenses are close to the emulsion layer and are the most evident. The influence of the lens effect during contact printing on the quality of the images obtained for the

case where round dark circles are copied was verified experimentally. The use of immersion during copying of the negative completely eliminates the negative influence of the lens effect. J.M.D.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

24

N65-25585# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

AN INVESTIGATION INTO THE RANGE OF DEFECT SIZES WHICH ARE DETECTABLE BY COLD NEUTRON SCATTERING MEASUREMENTS

D. G. Martin Mar. 1965 25 p refs

(AERE-R-4853) HMSO: 3s 6d

The long wavelength neutron scattering cross sections of different sizes of interstitial clusters and platelets, in a cubic primitive lattice up to a maximum of 343 and 361 interstitials, have been calculated per cluster and platelet which approximated the shape of cubes and squares. Effects of the relaxation of the neighboring lattice were neglected. Both differential cross sections as a function of scattering angle and total cross sections as a function of neutron wavelength were calculated to compare and determine the significance of the differences in shapes of the cross section curves as a function of aggregate size, standard errors have been introduced into the calculated results. Such a comparison shows that within the size range investigated all cluster sizes are distinguishable from one another by means of differential cross section measurements, but for platelets this is only true up to 81 interstitials per platelet. Total cross section measurements can distinguish clusters up to 64 interstitials per cluster, but larger sizes can be measured to an accuracy of about 40%. For platelets, up to 20 interstitials per platelet can be distinguished; larger sizes can be measured with an accuracy of between 30% and 70%, increasing with size. Author

N65-25588*# Giannini Controls Corp., Duarte, Calif. Control/Nucleonics Div.

LARGE STORAGE TANK MASS DETERMINATION STUDY, PHASE I Quarterly Report

J. G. Kyser 9 Apr. 1965 62 p refs

(Contract NAS8-11311)

(NASA-CR-63263; ER-80212) CFSTI: HC $3.00/MF $0.75 CSCL 18H

An analytical development of a radiation method of measuring the mass in large propellant containers (5 X 50 feet) was completed. Neutrons, charged particles, and electromagnetic radiation of various wavelengths were considered. Also, various geometrical arrangements were studied, and the requirements for a workable system were established. A functional diagram of the prototype system is presented which will have several identical channels measuring the mass in various sections of the tank. Each channel comprises a source, detector, collimating shield, differential pulse height discriminator, integral pulse height discriminator, integrator, power supply, pulse shaper, and magnetic tape into a computer where appropriate curve fitting and averaging will be accomplished. Cs^{137} was selected as the source because it is inexpensive, has a long half-life, is relatively easy to shield, and has a suitable absorption coefficient. E.E.B.

N65-25592*# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics

HIGH RESOLUTION EMISSION VEGARD-KAPLAN BANDS OF NITROGEN Technical Report No. 8

R. E. Miller Apr. 1965 20 p refs

(Grant NsG-193-62)

(NASA-CR-63250) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The Vegard-Kaplan system of nitrogen is an electrical dipole transition, occuring only by violating the approximation spin selection rule S=0. This system is of importance since it fixes the absolute energy of the triplet states. These bands are observed in the spectrum of the night sky and of the aurora, and are now being sought in the spectrum of other planetary atmospheres. A discussion of the spectrograph, wavelength standards, and light source used in the study of the Vegard-Kaplan band system of nitrogen is presented. An analysis of the resolution of the rotational structure, molecular constants, and absolute energy of the triplet levels in nitrogen is given. N.E.A.

N65-25623# New York Univ., N. Y. Courant Inst. of Mathematical Sciences

VARIATIONAL STUDIES OF THE FEW BODY NUCLEUS

S. Aranoff and J. K. Percus 15 Apr. 1965 93 p refs

(Contract AT(30-1)-1480)

(NYO-1480-18)

The model triton studied consists of three bodies interacting via a two-body central Gaussian potential. A type of polarized Gaussian wave function used in a minimal principle for the energy gives significantly lower energy than the unpolarized wave function. It has the advantages of simplicity and generality. The binding energy compares very well with an exact numerical solution of the problem, as well as the energy obtained by other means. Similar results were obtained for the alpha particle. A three-body potential can be written variously so that the wave function is an exact solution of the Hamiltonian formed by adding this potential to the original Hamiltonian. One way of considering this function is in coordinate space. A simple function was found to approximate this in regions where the wavefunction is not small. It has the form of a Gaussian times a quadratic expression. Another way is by using projection operators. Author

N65-25646# Atomic Energy Establishment, Winfrith (England).

MLBW—A MULTI-LEVEL BREIT–WIGNER COMPUTER PROGRAMME

K. Gregson (Bedford Inst. of Technol.), M. F. James, and D. J. Norton Mar. 1965 19 p refs

(AEEW-M-517) HMSO: 2s

MLBW is a Fortran computer program that calculates unbroadened neutron crossections for a nonfissile natural element from resonance parameters, using the multilevel Briet–Wigner approximation. Resonances can be considered that are excited by neutrons with orbital angular momentum quantum numbers 1 ranging from 0 to 5. Author

N65-25650# Atomic Energy Commission, Washington, D. C. Div. of Technical Information

PROCEEDINGS OF THE PHYSICS INSTITUTE NAMED FOR P. N. LEBEDEVA, VOLUME 14, 1962: STUDIES IN NUCLEAR PHYSICS

[1964] 451 p refs Transl. into ENGLISH of "Trudy Fizicheskogo Instituta Im P. N. Lebedeva, Volume 14, Issledovaniya po Yadernoi Fizike" Moscow, Publishing House of the Acad. of Sci., 1962 309 p refs

(AEC-TR-6526) CFSTI: $7.56

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N65-25651 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

CONTRIBUTION TO THE THEORY OF NONSPHERICAL NUCLEI IN ACCORDANCE WITH THE INDEPENDENT PARTICLE MODEL

D. A. Zaikin (Ph.D. Thesis) *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 1–85 refs (See N65-25650 15-24) CFSTI: $7.56

The construction of a nucleon level scheme in a rectangular spheroidal well by the method of asymptotic expansions of spheroidal functions is presented. The problem is formulated and solved for the case of an infinitely deep well without account of the spin–orbit interaction. Also, the finite depth of the well and the spin–orbit interaction are taken into account, and the resultant level scheme is compared with the experimental data with respect to the spins and parities of the ground and low-lying isomer states of odd nuclei, the shape of which differs strongly from spherical. Further, calculation is made for nucleon states which go over into the case of a spherically symmetrical well into s, p, d, and f states. Perturbation theory is used in the same manner as was done by Moszkowski in the problem of the energy levels of nucleons in a rectangular axially symmetrical well. The results of numerical estimates of the position of the minimum of the total energy of some nucleon configurations in the average field are also given. E.E.B.

N65-25652 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

SCATTERING OF 300-MEV PIONS BY HYDROGEN AND DEUTERIUM

I. B. Sokolova (Ph.D. Thesis) *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 86–167 refs (See N65-25650 15-24) CFSTI: $7.56

The cross sections and angular distributions were measured for the elastic scattering of 300 MeV positive and negative mesons by hydrogen. Also, a phase-shift analysis was made of the scattering of positive pions by hydrogen, with inclusion of S and P waves. The phase shifts obtained agreed with the dispersion relations for positive and negative mesons under the assumption that the coupling constant for meson–nucleon interaction is $f^2 = 0.08$ to 0.10. The cross sections and angular distributions were also measured for elastic scattering of positive and negative 300 MeV pions by deuterium. The differential cross section for elastic scattering of positive and negative pions by the deuteron did not agree with calculations made by Green and Rockmore. Agreement can be attained if it is assumed that the mass of the nucleon approaches infinity. The disparity between calculations and experiment is apparently connected with the inconsistent account of the nucleon recoil. The contribution of double scattering to the differential cross section of elastic scattering of pions by the deuteron does not exceed 10%. E.E.B.

N65-25653 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

PULSE METHOD FOR THE INVESTIGATION OF THE PROPERTIES OF SLOW NEUTRONS

I. M. Frank *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 168–209 refs (See N65-25650 15-24) CFSTI: $7.56

The use of a high-voltage ion tube in the flickering mode for the generation of neutrons uncovers the possibility of extensive use of pulsed sources in various fields of neutron physics. In this paper we discuss the possible applications of this method for the study of the properties of slow neutrons. It is most natural to use the pulse method for the determination of the neutron diffusion coefficient D and its dependence on the experimental conditions. In many cases it is possible to determine both D and the neutron lifetime T, and consequently also $L^2 = DT$. In order to carry out the measurements it is necessary in this case much less material than in the prism method. The method can yield information on the duration of the time of establishment of the stationary spectrum, the velocities of the neutrons, and the behavior of different groups of slow neutrons. The most complete information on the properties of neutron gas can be obtained by the method of "flickering prism," which makes it possible to determine also the value of the slowing-down parameter T. Author

N65-25654 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

INVESTIGATION OF THE PROCESSES OF DIFFUSION AND MODERATION OF NEUTRONS IN DIFFERENT MEDIA AND OF NEUTRON MULTIPLICATION IN URANIUM–GRAPHITE HETEROGENEOUS SYSTEMS WITH THE AID OF THE PULSE METHOD

A. V. Antonov *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 210–319 refs (See N65-25650 15-24) CFSTI: $7.56

The following problems, connected with the behavior of slow neutrons in moderating and multiplying media, were investigated: (1) nonstationary diffusion of neutrons in small blocks of moderators; (2) slowing-down process for neutrons in graphite; and (3) neutron diffusion in multiplying media. The theory of the processes of nonstationary diffusion for pure moderators and for neutron-multiplying systems are developed and the experimental measurements made on neutron diffusion are described. A method is proposed which makes it possible to determine the parameters which characterize multiplying systems. E.E.B.

N65-25655 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

INVESTIGATION OF THE REACTION D(T, n)He_4 BY THE THIN-TARGET METHOD IN THE ENERGY REGION FROM 40 TO 750 KEV

L. N. Katsaurov (Ph.D. Thesis) *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 320–373 refs (See N65-25650 15-24) CFSTI: $7.56

The number of bombarding particles was measured by determining the yield of alpha-particles from a target of heavy ice on which the beam was incident after passing through the gas target. In order to determine the number of bombarding particles corresponding to a given alpha-particle yield, before and after the measurements with the gas target, the gas was pumped out and measurements were made of the alpha-particle yield from the target of heavy ice per unit charge carried by the beam and registered with an integrator. The flow of gaseous deuterium was then set so that the necessary pressure was established in the gaseous target, and the yield of alpha-particles from the gaseous and ice targets was measured simultaneously. The gas was then again pumped out and the yield of alpha-particles on the solid targets per microcoulomb of incident particles measured. The dependence of the effective cross section on the energy was determined with a separate accelerator installation with the aid of thin titanium targets. Results are discussed in the light of previous measurements and sources of error are analyzed. E.E.B.

N65-25656 Atomic Energy Commission, Washington, D. C. Div. of Technical Information

DETERMINATION OF THE NUMBER OF SECONDARY NEUTRONS PRODUCED IN INELASTIC INTERACTION BETWEEN A FAST NEUTRON AND A HEAVY ATOMIC NUCLEUS

V. V. Nefedov (Ph.D. Thesis) *In its* Proc. of the Phys. Inst. Named for P. N. Lebedeva, Vol. 14, 1962: Studies in Nucl. Phys. [1964] p 374–422 refs (See N65-25650 15-24) CFSTI: $7.56

The number of secondary neutrons produced in inelastic interaction with uranium, lead, iron oxide, and copper is reported. Except for copper the values were experimental; the copper values were calculated from the known partial cross sections of the inelastic processes. The measurements were made for neutrons of 14 MeV and 2.5 MeV energy. A value of 2.7 ±0.2 is reported for uranium for 14 MeV neutrons and 1.13 ±0.08 for 2.5 MeV neutrons. Measurement of the number of secondary neutrons produced in interaction with lead and iron at 14 MeV showed that the cross section of the reaction (n, 2n) was much smaller than that expected from statistical theory. An examination of the possible nuclear transformations at such neutron energies leads to the conclusion that a decrease in the cross section of the reaction (n, 2n) for these elements is due principally to the strong competition on the part of the inelastic scattering. E.E.B.

N65-25686# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics

S. P. Khare [1965] 13 p refs

(Contract N62558-4297)

(AD-613929)

The differential cross sections for the elastic scattering of electrons by helium atoms at a few selected electron impact energies, in the 10-50 eV range, are calculated by the adiabatic-exchange phase shifts of Labhan and Callaway for the $l = 0$, 1 and 2 partial waves, and the static-dipole phase shifts for the higher partial waves. The calculated values agree with previous experimental and theoretical data. The effect of quadrupole polarizability potential on the differential cross sections is found to be small. Author

N65-25729# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

SOME LIFETIME MEASUREMENTS OF ISOMERIC STATES IN THE RARE EARTH REGION WITH MAGNETIC COINCIDENCE BETA-RAY SPECTROMETERS

Robert E. Mc Adams and Eastman N. Hatch Nov. 1964 180 p refs

(Contract W-7405-ENG-82)

(IS-1071) CFSTI: $5.00

Half-lives were measured using magnetic beta-ray spectrometers and an associated fast-slow coincidence system utilizing a time-to-pulse-height converter. The half-lives of the 8.40-, 118-, and 139-keV levels in Tm^{169} were determined to be (4.13 ±0.12) nsec, (63 ±7) psec, and (289 ±24) psec, respectively. The half-life of the 8.40-keV level was determined by both Er^{169} and Yb^{169} decay. Several different methods were used to measure the 8.40-keV level lifetime. Comparisons are made with theory for the K = 1/2 rotational band in Tm^{169}. The half-life obtained for the 8.40-keV level in Tm^{169} corresponds to an energy level width of $(1.10 \pm 0.03) \times 10^{-7}$ eV. If there were no broadening of the individual line profiles in the Mössbauer effect pattern, the width at half-maximum of the resolved Mössbauer lines would be $(2.20 \pm 0.06) \times 10^{-7}$ eV compared to the narrowest experimental Mossbauer gross line width of 5.04×10^{-7} eV. The half-lives of the 87- and 105-keV levels in Gd^{155} were found to be (6.27 ±0.35) nsec and (1.20 ±0.04) nsec, respectively. Comparisons were made with the theoretical predictions of Nilsson for these two levels. The theoretical-experimental comparison would assign a spin of 5/2 to the 105-keV level and a spin of 3/2 to the 87-keV level, if the comparison could be taken at face value. The half-396-keV level in Lu^{175}, and 80-keV level in Pr^{144} were also determined and found to be (1.36 ±0.06) nsec, (2.22 ±0.08) nsec, (3.31 ±0.10) nsec and (143 ±11) psec, respectively. Author

N65-25733# RAND Corp., Santa Monica, Calif.

DYNAMIC PROGRAMMING AND AN INVERSE PROBLEM IN NEUTRON TRANSPORT THEORY

R. E. Bellman, H. H. Kagiwada, and R. E. Kalaba Mar. 1965 24 p refs

(Contract AF 49(638)-700)

(RM-4495-PR)

Inverse problems in neutron transport theory were studied from a dynamic programing point of view to produce a feasible computational method for estimating the properties of a medium based on measurements of radiation fields within the medium. An invariant imbedding and quasi-linearization approach to transport theory is used. A one-dimensional transport process is considered and the method described is generalized to the vector-matrix case, and thus to the slab geometry with anisotropic scattering, to wave propagation, and to transmission lines. R.N.A.

N65-25823# Pennsylvania Univ., Philadelphia. Physics Dept.

TWO-PARTICLE CLUSTER THEORY OF ANTIFERROMAGNETISM

Herbert V. Callen and Earl Callen (Naval Ordnance Lab.) Feb. 1965 22 p refs

(Contract Nonr-551(36))

(TR-22; AD-612472)

The two-spin cluster theory of Strieb, Callen and Horwitz is extended to antiferromagnets. The theory is formulated to include nearest and next-nearest neighbor exchange (J_1 and J_2) and to apply to those types of antiferromagnetic Néel phases in which equal numbers of spins are nominally "up" and "down". When $J_2 = 0$ the theory reduces to the antiferromagnetic constant coupling theory of Kasteleijn and van Kranendonk. Consequently, the theory suffers from the defect of an anti-Néel transition at low temperatures. Author

N65-25860# American Meteorological Society, Boston, Mass.
THE CURRENT STATUS AND PROBLEMS OF THE CALCULATION OF ELECTRON SHELLS IN MOLECULES [SOSTOIANIE I ZADACHI RASCHETA ELEKTRONNYKH OBOLOCHEK MOLEKUL]
N. D. Sokolov Bedford, Mass., AFCRL, Jan. 1965 43 p refs Transl. into ENGLISH from Litovsk. Fiz. Sb., (Vilna), v. 3, no. 12, 1963 p 205–226
(Contract AF 19(628)-3880)
(T-R-459; AD-612483)

The main theoretical challenge in the development of quantitative calculations is to work out effective methods for including electron correlations. Methods have been developed recently for atoms and for molecules without conjugated bonds, but have been applied to individual cases only and are lacking for molecules with conjugated bonds. Relevant theory should be developed along the lines of field quantum-theoretical methods and of various models. A review of semiquantitative mathematical treatments of molecular and radical energies in ground and excited states, studies of molecular geometry, and calculations of weak interactions is included. Author

N65-25884# Los Alamos Scientific Lab., N. Mex.
THE INTERPRETATION OF NUCLEAR EXCITATION FUNCTIONS AT HIGH ENERGY: ERICSON FLUCTUATIONS
William R. Gibbs 27 May 1965 60 p refs
Contract W-7405-ENG-36)
LA-3266) CFSTI: $3.00

The interpretation of the nuclear reaction excitation function by statistical methods has been reviewed and some new results regarding errors and corrections have been presented. Special emphasis is placed on the effects of finite sample size on the amount of direct reaction cross section extracted. Also treated are the effects of counting statistics, generalized frequency distribution functions, and the effect of finite sample on frequency distribution functions. Author

N65-25913# Stanford Univ., Calif. High-Energy Physics Lab.
PHOTODISINTEGRATION OF THE DEUTERON BY POLARIZED PHOTONS
F. F. Liu Nov. 1964 22 p refs Sponsored in part by ONR, AEC, and AFOSR
(HEPL-356; AD-614276)

The asymmetry in the photodisintegration of the deuteron by polarized photons has been measured between photon energies of 75 and 230 MeV. Measurements were made mostly at 90° in the center of mass system, but limited data at 45° and 135° were obtained. The data below 140 MeV are compared with current theories. At 90°, results are generally smaller than theoretical calculations. The measured asymmetry changes sign at about 130 MeV and shows a backward peaking at the high energy points. Author

N65-25915# Naval Research Lab., Washington, D. C. Radiation Div.
GROUP THEORETIC MODEL INTERACTIONS AS AN APPROACH TO 2s-1d SHELL NUCLEI. THE LEVEL STRUCTURE OF FLUORINE-20 Interim Report
M. de Llano, Jr. (Ph.D. Thesis—Catholic Univ. of Am.) 10 Mar. 1965 243 p refs
(Grant NSF GP-3217; ARPA Order 306-62)
(NRL-6256; AD-613008)

Based on the studies of S. Lie and E. Cartan in the theory of continuous groups of transformations, M. Moshinsky has reformulated the nuclear shell many-body problem in second-quantization language. The methods due to J. P. Elliott for simplifying the basis set of state functions by classification according to the group SU(3) are recast into the above-mentioned reformulation. The purpose is to make low-energy nuclear calculations feasible for nuclei with 4 and more particles in the 2s-1d shell and thus render the possibility of probing for SU(3) symmetries in these nuclei. A Hamiltonian model consisting of pairing and quadrupole-quadrupole terms is known to approximate respectively the short- and long-ranged correlations between nucleons given by an arbitrary, reasonably shaped two-nucleon central interaction potential. The former model is generalized to include exchange effects at the long range as well as spin-orbit coupling, and is studied in detail from the viewpoint of its various group symmetries. It is then employed to calculate the low-lying levels of fluorine-20 which show reasonable accord with the empirical level-scheme. Author

N65-25930# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
NEUTRON CROSS-SECTIONS OF Be9 IN THE ENERGY RANGE 1 MeV TO 15 MeV
G. Doherty Mar. 1965 13 p refs
(AEEW-M 513) HMSO: 2s

Self-consistent neutron cross sections for the energy range 1 to 15 MeV are tabulated. The cross section for the n,2n reaction in the important energy region 2 to 4 MeV is not well determined, but the shape has been adjusted to give agreement with a recent integral measurement. The angular distribution of elastically scattered neutrons, and the energy distribution of neutrons from the n,2n reaction are not reviewed. The tabular data have been used to prepare revised data in the U.K.A.E.A. nuclear data library. Author

N65-25978# Ohio State Univ. Research Foundation, Columbus. Dept. of Physics
X-RAY SPECTROSCOPY Final Report, 1 May 1958–31 May 1964
C. H. Shaw and E. L. Jossem Jul. 1964 52 p refs
(Contract Nonr-495(16))
(Rept.-809-15; AD-612925)

X-ray reflection characteristics of natural and synthetic quartz crystals were studied. Synthetic quartz was found to be as good or better than natural quartz. Radiation produced no observable effects on the X-ray diffraction patterns. It was shown that crystal pairs can be characterized by using complete rocking curves and that a comparison of these curves is the only reliable method of crystal selection. The L X-ray emission spectra of Zr, Nb, and Mo were investigated and graphical data is presented. The design considerations of a two crystal X-ray spectrometer are discussed. R.N.A.

N65-26044*# Pittsburgh Univ., Pa. Space Research Coordination Center
MOMENTUM TRANSFER THEOREM FOR INELASTIC PROCESSES SRCC Report No. 4
E. Gerjuoy 10 May 1965 22 p refs
(Grant NsG-416)
(NASA-CR-63227) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Recently it has been shown that for potential scattering, the well known optical theorem—relating the total cross section to the imaginary part of the forward scattering amplitude—can be generalized to yield a "momentum transfer cross section theorem" The present paper further generalizes the previous potential scattering result. Specifically, it appears that the momentum transfer cross section theorem is valid also for many-particle systems, wherein inelastic processes occur. Although this last assertion probably holds quite generally, a

proof is given only for the collisions of electrons with atomic hydrogen. The proof takes into account electron indistinguishability, as well as the possibility that the incident electron ionizes the atom, but assumes the forces are not spin-dependent. Author

N65-26074# Aspen Inst. for Humanistic Studies, Colo. Physics Div.
[A REPORT ON A SERIES OF RESEARCH CONFERENCES ON THEORETICAL PHYSICS, 8 JUN.–4 SEP. 1964]
Robert Murray et al 1964 65 p refs
(Contract Nonr-4460(00))
(AD-613057)

Abstracts of research activities by participants in the conference are presented. In addition, there is a brief report on the work of the Commission on College Physics, at which conferences developed new styles and methods for the presentation of physics materials. M.W.R.

N65-26110# Innsbruck Univ. (Austria). Dept. of Theoretical Physics
PRINCIPAL IDEAS ON SPINOR TRANSFORMATIONS IN THE RIEMANNIAN SPACE
Walter Majerotto 25 Aug. 1964 17 p refs
(Contract DA-91-591-EUC-2947)
(Rept.-8; AD-613713)

It is shown that it is impossible to construct "Riemannian spinors" such that their transformations are homomorphic to the Riemannian transformations or the representations of the latter contained in the former, similar to the representations of the tensor transformations of the Lorentz group are contained in the spinor representations of the unimodular group C_2. does not eliminate the possibility of introducing the spinor concept in the Riemannian space without making the spinor into an invariant TAB

N65-26116# Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
A SOLID STATE NUCLEAR DETECTOR Final Report
G. E. Wilcox 23 Mar. 1965 22 p
(NADC-EL-6504; AD-614432)

A study was undertaken to determine the applicability of photoconductive (PC) and electroluminescent (EL) materials to a scintillation system for the detection and measurement of nuclear radiation. Efforts to amplify individual light flashes from scintillation phosphors by using ELPC sandwiches as light amplifiers met with little success because of the slow response time characteristic of the photoconductor. This characteristic, however, made the PC element a valuable integrating device, and a simple, reliable, and economical solid state ratemeter was developed and evaluated for the measurement of alpha, beta, gamma, and neutron dose rates over a wide range of operation. Author

N65-26124# General Dynamics/Fort Worth, Tex.
A CONSISTENT-VIBRATIONS MODEL OF THE INTERNAL DYNAMICS OF LIQUID HYDROGEN Technical Report, 1 Oct. 1963–30 Sep. 1964
H. G. Carter Kirtland AFB, N. Mex., AF Weapons Lab. Mar. 1965 62 p refs
(Contract AF 29(601)-6213)
(FZK-197; WL-TR-64-162; AD-614039)

A model describing the internal dynamics of a nonassociated liquid has been constructed for use in the calculation of cold-neutron scattering cross sections and free-radical recombination rates in liquid hydrogen. The proposed model assumes that the specification of a given temperature and density implies a quiescent state in which each molecule vibrates with random phase in a field set up by the sum of the position probability densities of its neighbors, the central sites of which comprise a close-packed quasi-lattice. A computer program has been written to calculate the consistent vibration frequency, the molecular well depth, the internal energy, the entropy, and the free energy of a liquid with a given temperature and density and with known Lennard-Jones parameters of the intermolecular interaction. Application of the program to the case of liquid hydrogen at points on the P-V-T surface ranging from 20° to 28° K along the saturation line has given predictions of thermodynamic properties which are in good agreement with experimental data. It is tentatively concluded that the model anticipates the most significant general features of motion in the liquid and may be implemented in calculations of cross sections and recombination rates which are dependent on the details of the internal dynamics and microscopic structure. Author

N65-26135# Los Alamos Scientific Lab., N. Mex.
A QUANTUM- AND CORRELATION-CORRECTED THOMAS-FERMI-DIRAC EQUATION WITH A FORTRAN CODE
John F. Barnes 28 May 1965 49 p refs
(Contract W-7405-ENG-36)
(LA-3268)

In a previously published report (LA-2750, A Proposed Modification of the Available Momentum Region in Thomas-Fermi Theory) a "quantum correction" to the statistical model of the atom was derived in detail. In the present work we use these results and a very simple approximation to the correlation energy in deriving a quantum- and correlation-corrected Thomas-Fermi-Dirac (TFD) equation. One expects the radial density distribution and potential calculated from this equation to be improved over those on the TFD model, both near the nucleus and near the outer boundary of the atom or ion. Minimum-energy (that is, zero boundary pressure) solutions for rare-gas atoms possess values of cell radius in good agreement with those calculated from experimental values of the lattice parameter. A Fortran code is included in an Appendix to the report. Author

N65-26320# General Dynamics Corp., San Diego, Calif. Johns Hopkins Lab. for Pure and Applied Science
KINETIC THEORY OF RADIATION IN A PLASMA
R. E. Aamodt, O. Eldridge, and N. Rostoker 1 Nov. 1963 32 p refs Presented at the 5th Ann. Meeting of Div. of Plasma Phys. Am. Phys. Soc., San Diego, Calif., 6–9 Nov. 1963 Submitted for Publication
(Contract AF 29(601)-5338)
(GA-5318; AD-461049)

The kinetic theory of a system of nonrelativistic charged particles constituting a fully ionized classical plasma and interacting via longitudinal and transverse electromagnetic forces was studied by using the Liouville equation for an ensemble of systems described by both particle and field variables. It is shown that starting with the conventional oscillator approach, but taking moments of the oscillator equations before expanding in the discreteness parameters, a consistent set of correlation equations can be derived. Further, it is shown that the field temperature changes to the particle temperature at the same time that the Fokker–Planck equation for the particles is realized. Also, a superposition principle for dressed test particles is derived which is a simple generalization of the longitudinal test particle theorem. E.E.S

N65-26334# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
SPHARCYL: A COMPUTER PROGRAM FOR USE IN APPLICATIONS OF THE SPHERICAL HARMONICS METHOD
H. H. Clayton Apr. 1965 16 p refs
(AECL-2246) Available from Atomic Energy of Canada, Chalk River: $0.50

This report describes an APEX procedure intended for use in applications of the spherical harmonics method to the approximate solution of one-group neutron transport problems in a multilayer region having complete cylindrical symmetry. Author

N65-26343# Harvard Univ., Cambridge, Mass. Cyclotron Lab.
[PARTICLE PHYSICS, NUCLEAR MAGNETISM AND NUCLEAR SPECTROSCOPY, AND MOLECULAR BEAM RESEARCH] Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
A. M. Koehler et al 1 Mar. 1965 13 p
(Contract Nonr-1866(19))
(AD-612914)

Reports are presented on research in the following areas: quasi-elastic proton-proton scattering, proton-proton bremsstrahlung, neutron total cross sections, monokenetic neutron beam, n-p incoherent scattering cross section, radiobiology, whole-body proton exposure, and nuclear magnetism and nuclear spectroscopy. TAB

N65-26447# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Physics Div.
PROGRESS REPORT, 1 JANUARY–31 MARCH 1965
[1965] 52 p refs
(AECL-2256; PR-P-65) Available from Atomic Energy of Canada, Chalk River: $1.50

Weak gamma-ray transitions in ^{20}Ne were identified by alpha-particle–gamma-ray coincidence measurements following the reaction $^{12}C(^{12}C,\alpha,\gamma)^{20}Ne$. The results combined with other data implied close correlation between the protons and neutrons in ^{20}Ne. A preliminary analysis of runs on the thermal neutron fission of ^{235}U and ^{239}Pu indicates that an average of 0.5 neutrons were emitted during scission and about 2 neutrons evaporated from fragments in flight. A frequency distribution function for the normal modes of the lattice vibrations was derived from dispersion curves for UO_2 at 296° K and in turn yielded the lattice specific heat and the Debye–Waller factors for the uranium and oxygen ions. It was found that UO_2 undergoes a transition at 28° K to an antiferromagnetic structure. Preliminary dispersion curve measurements were carried out with alloys of niobium to molybdenum atom ratios of 3:1, 1:1, and 1:3 respectively. Drifting of lithium for 7 mm into the sides and bottom of a germanium ingot resulted in a sensitivity volume of 16 cm^3 for a coaxial diode. A number of programs for the G-20 computer were developed. G.G.

N65-26475# Oak Ridge National Lab., Tenn.
PHYSICS DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING DECEMBER 31, 1964
J. L. Fowler and H. B. Willard May 1965 205 p refs
(Contract W-7405-ENG-26)
(ORNL-3778) CFSTI: $6.00

Selected articles on nuclear structure, reactions, and associated phenomena are presented. For individual titles see N65-26476 to N65-26507.

N65-26477 Oak Ridge National Lab., Tenn.
MULTIPLE IONIZATION IN ATOMS AND ITS RELATIONSHIP WITH ELECTRON CORRELATION
T. A. Carlson and M. O. Krause *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 9–13 refs (See N65-26475 15-24) CFSTI: $6.00

The photoionization in the outer shells of He, Ne, and Ar was investigated. The results showed that the process often occurs with the ejection of more than one electron. Likewise, double electron emission was found with Auger processes, the K–LL transition in neon and the L–MM transition in argon. The investigation of multiple ionization was based on measurements of the relative abundances of the differently charged ions formed as the result of X-rays. The studies were carried out with a specially designed mass spectrometer at gas pressures low enough to preclude ions molecule reactions. E.E.B.

N65-26481 Oak Ridge National Lab., Tenn.
HARTREE-FOCK CALCULATIONS OF FINITE NUCLEI
K. T. R. Davies and M. Baranger (Carnegie Inst. of Technol.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 22–23 refs (See N65-26475 15-24) CFSTI: $6.00

Two related phases of the Hartree–Fock program are discussed: (1) the determination of a two-body force or effective interaction; and (2) the evaluation of the most general types of two-body matrix elements encountered in Hartree–Fock calculations. Local, Gaussian potentials with velocity-dependent repulsive parts are used. This interaction is of the same form as the potential used by Green, although the force is parametrized in a different way. In particular, the ranges of the repulsive parts are not nearly as short. Computer programs were written for calculating the two-body data, the energy and density of nuclear matter, and the second-order Goldstone terms in nuclear matter. Fits to the relevant data are then made. E.E.B.

N65-26482 Oak Ridge National Lab., Tenn.
CALCULATION OF THE PROPERTIES OF THE GROUND STATE OF ^{16}O IN THE BRUECKNER APPROXIMATION
R. L. Becker and A. D. Mac Kellar (Texas A. and M. Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 24–25 refs (See N65-26475 15-24) CFSTI: $6.00

The use of perturbation theory in terms of a reaction matrix instead of the nucleon–nucleon potential for the calculations of nuclear properties in which realistic strong nuclear interactions are used is discussed. An approach to the Brueckner approximation for closed-shell nuclei, which avoids the local density approximation by calculating reaction matrix elements directly between shell model states was outlined by Eden and Emery. The method relies on the ease of expanding products of single particle harmonic oscillator wave functions in terms of similar wave functions in center-of-mass and relative coordinates. Calculations were performed for O^{16} in which the details of the Eden-Emery calculation were improved upon in several ways. Also, greater numerical accuracy was attained. The calculated ground state binding energy of O^{16} is shown as a function of the harmonic oscillator range parameter. E.E.B.

N65-26483 Oak Ridge National Lab., Tenn.
LEVEL SPACINGS AND s-WAVE NEUTRON STRENGTH FUNCTIONS OF THE ISOTOPES OF HAFNIUM
T. Fuketa (Japan Atomic Energy Res. Inst., Tokai) and J. A. Harvey *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 38–44 refs (See N65-26475 15-24) CFSTI: $6.00

Neutron transmission measurements were made on e p riched samples of the six isotopes of hafnium from Hf^{174} to Hf^{180} by use of a fast-chopper time-of-flight spectrometer.

The measurements were made from 0.2 to about 240 eV with an energy resolution from 1% to 2% below 50 eV and 60 nsec/m above 50 eV with the 45-m flight path. The enriched hafnium samples were all used in the powdered oxide form. The transmission data were analyzed, using the area and shape analysis programs, and parameters were obtained for about 100 resonances. The number of resonances is plotted vs neutron energy for the odd and even target nuclides. Also, the sums of the reduced neutron widths are plotted as a function of neutron energy for odd and even target nuclides. Further, the s-wave strength function and the average level spacing per spin state are given for the hafnium isotopes. E.E.B.

N65-26484 Oak Ridge National Lab., Tenn.
HIGH-RESOLUTION MEASUREMENTS OF THERMAL NEUTRON CAPTURE GAMMA RAYS
G. G. Slaughter and J. A. Harvey *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 44–53 refs (See N65-26475 15-24) CFSTI: $6.00

Gamma ray spectra were taken following thermal neutron capture in samples of Bi, U^{238}, Nb, Sn, and Y. Many previous unreported gamma-ray lines were observed in the U^{238} reaction. The most significant feature of the spectrum was the resolution of a group of lines around 4060 keV. Previous measurements with an NaI detector showed a single line at 4.06 MeV which exhibited a remarkable lack of intensity variation from resonance to resonance. The resolution of this line into at least four other lines at 3981, 3987, 4059, and 4094 keV within the resolution width of an NaI crystal indicates that the contributions of these lines are responsible for the lack of variation of the single line as seen by the NaI crystal. Other unreported lines of significant intensity were found at 4585, 4622, and 4675 keV. Gamma-ray spectra from thermal neutron capture by the isotopes of tin were also measured. A strong gamma ray with an energy of 9.31 MeV was observed from thermal neutron capture in an 89% enriched Sn^{117} tin sample. E.E.B.

N65-26485 Oak Ridge National Lab., Tenn.
CAPTURE CROSS-SECTION MEASUREMENTS ON ^{182}W, ^{183}W, ^{184}W, AND ^{186}W AT THE RPI LINAC
R. C. Block, J. E. Russell, and R. W. Hockenbury (Rensselaer Polytech. Inst.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 53–64 refs (See N65-26475 15-24) CFSTI: $6.00

Radiative capture measurements were made on samples enriched in W^{182}, W^{183}, W^{184}, and W^{186}. The measurements were made over a neutron energy range of 4 eV to 10 keV, at 0.1 microsec-wide electron burst; the time resolution for the capture measurements was about 5 nsec/m at the higher neutron energies. The capture cross section curves of the tunsten isotopes show that at low energies the resonances are quite well resolved from each other, but in the keV energy region the effect of finite resolution shows up in the merging of the resonances. These data were analyzed for the energies of the observed resonances through the use of a computer code which located the center of each resonance by least squares fitting a second-order polynomial to each peak in the capture cross section. E.E.B.

N65-26486 Oak Ridge National Lab., Tenn.
GAMMA-RAY SPECTRA FROM NEUTRONS CAPTURED IN ^{56}Fe AT THE 1148-ev RESONANCE
R. C. Block *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 64–69 refs (See N65-26475 15-24) CFSTI: $6.00

The gamma ray spectra from neutrons captured in Fe^{56} at the 1148 eV resonance was determined. The thermal and resonance capture pulse-height spectra are shown. Considering that the resonance and thermal spectra are produced by p-wave and s-wave capture, the two spectra are surprisingly similar in that both spectra are dominated by a strong 7.64-MeV gamma ray going to either the Fe^{57} ground state or first excited state at 0.014 MeV. However, the strong 5.95-MeV line in the thermal spectrum does not show up in the resonance capture, but a strong line is observed in resonance capture at 6.36 MeV which does not show up in the thermal capture. In addition, there are two weak gamma rays with energies slightly smaller than the binding energy of the neutron at 7.48 and 7.38 MeV for resonance and thermal capture, respectively. E.E.B.

N65-26487 Oak Ridge National Lab., Tenn.
STUDY OF THE EVEN-EVEN COMPOUND NUCLEI AT THE FIRST s-WAVE STRENGTH FUNCTION RESONANCE
W. M. Good, Daniel Paya (Commissariat a l'Energie Atomique, (France)), and Rolf Wagner (Physik. Inst., Basel Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 69–75 refs (See N65-26475 15-24) CFSTI: $6.00

The total cross sections of Ca^{43}, Ti^{47}, Ti^{49}, Cr^{53}, Fe^{57}, Cu^{63}, and Cu^{65} were measured up to 60 keV to determine what, if any, effect closure of the $f_{7/2}$ shell has on the strength function. The strength functions of the even-even compound nuclei as a function of mass of target in the region of the first s-wave resonance are shown. Also, the individual resonance parameters are tabulated. Relatively good agreement between theory and experiment was obtained. Also, the previous experimental value for Cr^{53} is discussed in light of the present experiment. E.E.B.

N65-26488 Oak Ridge National Lab., Tenn.
A STUDY OF THE RESONANCE STRUCTURE OF THE EVEN ZIRCONIUM ISOTOPES AT BELOW 69-kev NEUTRON ENERGY
J. A. Biggerstaff, W. M. Good, and H. J. Kim *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 76–81 refs (See N65-26475 15-24) CFSTI: $6.00

A previous report on the neutron total cross sections and strength functions of the isotopes of zirconium indicated a large average value for the strength function of 1.5×10^{-4} compared with the value of 0.3×10^{-4} shown by nuclei of mass greater than 90. Furthermore, the data were such as to leave in doubt the character of the cross sections between resonances. Measurements were therefore made with increased sample thicknesses for purpose of (1) confirming the previous results; (2) extending the measurements to higher energy; and (3) improving the between-resonance statistics. Cross section measurements, both present and previous values, are shown. Also, the individual resonance parameters are listed, and the statistical parameters are tabulated. Results are discussed in light of the previous work and the work of Moskalev on the same subject. E.E.B.

N65-26489 Oak Ridge National Lab., Tenn.
METHOD FOR OBTAINING BURSTS OF POLARIZED NEUTRONS OF ENERGY 10–700 kev
J. W. T. Dabbs and J. A. Harvey *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 83–84 refs (See N65-26475 15-24) CFSTI: $6.00

In considering the use of an electron linear accelerator, the observation was made that the energy at which most neutrons will be produced in a tungsten or uranium target agrees almost exactly with the peak in both polarization and cross section

for scattering of neutrons through an angle of 90° ±15° from helium—about 1.2 MeV. The calculated polarization of such a scattered beam is about 50% to 60%, with only slight dependence on angle, and the effective intensity is about 0.5% of that without the scattering. The scattering requires about 1 cm thickness of liquid helium at 4.2° K with a heat input expected to evaporate about one liter of liquid helium per hour at the expected neutron intensity from the linac. The median neutron energy after a single 90° scattering from He^4 is about 700 keV. Such a polarized, scattered beam can be moderated to lower energies without appreciable loss of polarization by a spin-zero moderator. Neutron intensity appears usable down to about 10 keV. E.E.B.

N65-26490 Oak Ridge National Lab., Tenn.
DIFFERENTIAL SCATTERING OF NEUTRONS FROM ^{16}O
C. H. Johnson and J. L. Fowler *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 85–88 refs (See N65-26475 15-24) CFSTI: $6.00

The total neutron cross section of O^{16} was measured with 5-keV resolution. It was found that the 3.77 MeV resonance was a 5/2 resonance with a width of 20 keV. An analysis showed a $d_{3/2}$ resonance at 3.40 MeV about 500 keV wide, a $d_{3/2}$ resonance at 3.82 MeV 50 keV wide, and a $p_{3/2}$ resonance at 3.75 MeV about 500 keV wide. The broad $d_{3/2}$ resonance corresponds to about 1/2 of the single-particle limit. There is, of course, already a $d_{3/2}$ resonance with a very large fraction of the single-particle limit at 1 MeV. The $p_{3/2}$ resonance at 3.75 MeV is about 1/5 of the single-particle limit, and the $f_{5/2}$ resonance at 3.77 MeV is about 1/10 of this limit. E.E.B.

N65-26491 Oak Ridge National Lab., Tenn.
RESONANCE PARAMETERS FOR NEUTRON SCATTERING FROM ^{208}Pb
J. L. Fowler *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 89–92 refs (See N65-26475 15-24) CFSTI: $6.00

The resonance states observed by scattering neutrons from Pb^{208} were among the first to be compared with theoretical expectations for intermediate states. The total cross section of Pb^{208} was measured with about 3 keV energy resolution. Of the some 85 resonances that occur between 0.7 and 1.9 MeV, about 1/3 are sufficiently isolated and resolved so that values of total angular momentum can be assigned. A set of differential cross sections plotted as a function of the center-of-mass angle is shown. The data were corrected for the effects of angular resolution, multiple scattering, and the second group of neutrons from the Li(p,n) reaction. These cross sections are shown from 1.586 to 1.646 MeV and from 1.701 to 1.761 MeV. E.E.B.

N65-26492 Oak Ridge National Lab., Tenn.
TOTAL NEUTRON CROSS SECTIONS OF HYDROGEN AND CARBON IN THE 20–30 Mev REGION
M. L. West II (Texas Univ.), C. M. Jones, and H. B. Willard *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 94 (See N65-26475 15-24) CFSTI: $6.00

The total neutron–proton cross section was measured and used to normalize the n–p angular distributions. Also, the transmissions of polyethylene and carbon were measured to determine their respective total cross sections, and a difference technique was used to extract the hydrogen cross section. The polyethylene sample had a hydrogen-to-carbon ratio of (2.038 ±0.020):1 with no significant impurities. The carbon sample was an experimental-grade graphite specified to be 99.98% pure. Preliminary results are tabulated. Corrections were made for background and inscattering effects. Neutron energies were known to better than 0.2%. E.E.B.

N65-26493 Oak Ridge National Lab., Tenn.
CROSS SECTIONS FOR (p,n) REACTIONS IN FIVE ISOTOPES OF TIN
R. L. Kernell (Tenn. Univ.) and C. H. Johnson *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 95–97 refs (See N65-26475 15-24) CFSTI: $6.00

The cross sections for the (p,n) reaction in Sn^{124} were determined. The cross section increases from a few thousandths of a millibarn near 2 MeV to 42 millibarns at 5.5 MeV. The cross sections of the other isotopes of tin were also determined relative to Sn^{124}. Values below about 3 MeV are uncertain because of relatively high yields from target contaminants. Also, the threshold for the reaction $^{120}Sn(p,n)Sb^{120}$ was determined to be 3494 ±7 keV. This corresponds to $Q = -3465$ ±7 keV. E.E.B.

N65-26494 Oak Ridge National Lab., Tenn.
ISOBARIC ANALOG STATES IN ^{90}Zr, ^{116}Sb, ^{118}Sb, AND ^{120}Sb
C. H. Johnson and R. L. Kernell (Tenn. Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 97–100 refs (See N65-26475 15-24) CFSTI: $6.00

The total (p, n) reaction cross sections were measured for Y^{89} Sn^{115}, Sn^{117}, and Sn^{119} at energies from 3.6 to 5.1 MeV. The data are shown for the $^{89}Y(p, n)Zr^{89}$ reaction for a target 6 keV thick at 5 MeV. The (p, n) reactions for the odd isotopes of tin are shown for target thicknesses of about 10 keV, somewhat narrower than the isobaric analog resonances. Smooth curves calculated from an optical model and normalized to fit the off-resonance cross sections are also given. E.E.B.

N65-26495 Oak Ridge National Lab., Tenn.
ELASTIC AND INELASTIC SCATTERING OF 12- AND 13-Mev PROTONS FROM ^{106}Pd and ^{108}Pd
R. L. Robinson, J. L. C. Ford, Jr., P. H. Stelson, and G. R. Satchler *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 101–103 refs (See N65-26475 15-24) CFSTI: $6.00

The differential cross sections of protons elastically and inelastically scattered from Pd^{106} and Pd^{108} were measured. The spectra of 13-MeV protons scattered from a Pd^{106} target through an angle of 115°; from a Pd^{108} target through an angle of 90°; differential cross sections divided by the Rutherford cross section for 13-MeV protons elastically scattered from Pd^{106} and 12- and 13-MeV protons scattered from Pd^{108}; and the differential cross sections for 13 MeV protons inelastically scattered by Pd^{106} and Pd^{108} are given E.E.B.

N65-26496 Oak Ridge National Lab., Tenn.
$^{15}N(^3He,p)^{17}O$ AND $^{15}N(^3He,d)$ ^{16}O REACTIONS AND INTERMEDIATE RESONANCES
K. K. Seth, G. Walter (Northwestern Univ.), P. D. Miller, J. A. Biggerstaff, and G. R. Satchler *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 104–110 refs (See N65-26475 15-24) CFSTI: $6.00

Angular distributions at 6.41 MeV incident energy of He^3 were measured for the reactions $^{15}N(He^3,d)O^{16}$ and $^{15}N(He^3,p)O^{17}$. From these data the states in residual nuclei were deduced. Doubly charged He^3 ions of about 6.4 MeV were

incident on an isotopically pure N^{15} gas target confined in a small scattering chamber. A pulse-height spectrum is illustrated from which groups from the reactions $^{15}N(He^3,\alpha)N^{14}$ and $^{15}N(He^3,d)O^{16}$ can be noted. Strong proton groups corresponding to excitation of the 8th, 18th, and ≈ 35th excited states of O^{17} are particularly noted. From this reaction significant observations were: (1) While a weak ground-state transition (to 0^+) was observed, transitions to the second 0^+ and the 2^+ excited states were not observed. (2) Strong transitions to all three negative parity states were observed. For the (He^3,p) reaction, it was observed that: (1) The relative cross sections for the three positive parity states were 1.00, 1.4, and 0.69 and for the negative parity states were 2.4, 1.4, 1.9, and 2.2. The reduced yields of the five adjoining negative parity states were 2.4, 1.4, 1.4, 1.9, and 2.2. The significance of these results is discussed. E.E.B.

N65-26497 Oak Ridge National Lab., Tenn.
LOW-LYING LEVELS IN ^{75}As
R. L. Robinson, F. K. Mc Gowan, J. L. C. Ford, Jr., and P. H. Stelson *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 112–115 refs (See N65-26475 15-24) CFSTI: $6.00

Coulomb excitation was achieved by the reactions ^{75}As $(\alpha,\alpha\gamma)$ and $^{75}As(O^{16},O^{16}\gamma)$. A thick arsenic target was bombarded with helium and oxygen ions at 3.5 to 8.1 MeV and 36 to 38 MeV energies, respectively. The gamma-ray spectrum for the 36-MeV oxygen ions is illustrated. Also, the energy-level diagram of Coulomb excited levels in As^{75}; the $B(E2)_{ex}$ levels in As^{75} (reduced transition probabilities for excitation); experimental angular distribution coefficients; and level and gamma-ray properties are tabulated. Angular anisotropies for the strongest transitions were measured relative to the direction of the incident beam for E_α = 3.5, 5.1, and 7.1 MeV and data were fitted to the equation $W(\Theta) = 1 + a_2 g_2 A_2 P_2(\cos\theta)$ where a_2 and g_2 are the thick-target particle parameter and the correction for the finite angular resolution of the detector, respectively. E.E.B.

N65-26498 Oak Ridge National Lab., Tenn.
GAMMA-RAY SPECTROSCOPY WITH A LITHIUM-DRIFTED GERMANIUM DETECTOR
R. L. Robinson, P. H. Stelson, F. K. Mc Gowan, J. L. C. Ford, Jr., and W. T. Milner *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 116–119 refs (See N65-26475 15-24) CFSTI: $6.00

The energies of gamma-rays from about 50 nuclides were determined to within a few tenths of a keV by means of a lithium-drifted germanium detector. This accuracy is about an order of magnitude better than has generally been achieved with the NaI detector, due principally to the superior resolution of the germanium detector. The calibration sources are tabulated to show the gamma rays energies. Also, energy values were estimated for gamma rays which are frequently used as energy standards but which have greater uncertainities than those tabulated. The energies found for gamma rays resulting from the decay of the radioactive nuclei Rh^{102} and Rh^{106} are also given. In both nuclei, two near-lying transitions between members of the two-phonon states and the first 2^+ state were resolved. The energies determined for gamma rays resulting from Coulomb excitation by bombardment of thick targets of the enriched isotopes with 7- to 9-MeV alpha particles are presented. In several spectra a line due to the O^{18} (α, n) reaction was observed. From this, the energy for the first excited level of Ne^{21} was estimated as 350.2 ±0.8 keV. The spectrum of gamma rays from Coulomb excited Se^{77} is included. E.E.B.

N65-26499 Oak Ridge National Lab., Tenn.
DECAY OF $^{79}Kr \rightarrow ^{79}Br$
R. L. Robinson *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 119–122 refs (See N65-26475 15-24) CFSTI: $6.00

Four samples of Kr^{79} were produced by bombardment of KBr with 4.1 MeV protons from 4 to 12 hrs. To eliminate the contributions from activities with short lifetimes, gamma-ray studies were not undertaken until several hours after the completion of the bombardment. No chemistry was performed. A typical singles gamma-ray spectrum as taken by a 3- by 3-inch NaI crystal is shown. The rate of decay of the 12 strongest peaks was followed over a period of up to 300 hr. All but peaks at 95, 186, and 1114 keV were found to have half-lives consistent with the 35-hr half life of Kr^{79}. Also, the gamma-ray spectrum of Kr^{79} as measured with a lithium-drifted germanium detector is given. Additional gamma rays were revealed. Energies were determined to approximately 1 keV. A proposed decay scheme consistent with the experimental data is presented. There were a number of indications in the present investigation that the complexity of the Kr^{79} decay is considerably greater than shown. However, a more thorough investigation is needed to establish the reality of weak transitions and other levels. E.E.B.

N65-26500 Oak Ridge National Lab., Tenn.
SOME HEAVY-ION STOPPING POWERS
C. D. Moak and M. D. Brown (Tenn. Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 123–125 refs (See N65-26475 15-24) CFSTI: $6.00

Stopping powers of several materials were measured by placing foils of known thicknesses in front of the detector and measuring the shifts of the various peaks in the spectrum. Foils of Be, C, Al, Ni, Ag, and Au were prepared by evaporation onto very thin carbon films. Foil thicknesses were measured by obtaining alpha-particle energy-loss data for each foil and converting these to thickness with the aid of alpha-particle stopping power curves. The stopping power curves for Br and I ions are given. Experimental errors are thought to be mostly systematic in that alpha-particle stopping power error would be contained in the results, as well as any systematic errors contained in the procedure for foil thickness measurement. Total experimental error is believed to be ±10% for the final results shown. E.E.B.

N65-26502 Oak Ridge National Lab., Tenn.
FISSION OF ORIENTED NUCLEI
J. W. T. Dabbs and G. W. Parker *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 127–129 refs (See N65-26475 15-24) CFSTI: $6.00

A number of difficulties with the cryostat modifications are discussed. The three major difficulties discussed in detail are: (1) The rotating counter arrangement was found to operate at a much higher temperature than expected. (2) The sample container surface exposed to radiant heat from the detector is now 30 sq cm compared with 3 sq cm previously. (3) The area of the thin (225 μg per sq cm) nickel window was enlarged from 3 sq cm to 27 sq cm. The observed counting rates were increased by a factor of about 9 and all the electronic apparatus was in satisfactory operation. Data obtained, however, were insufficient to justify presentation. E.E.B.

N65-26503 Oak Ridge National Lab., Tenn.
FISSION FRAGMENT ENERGY CORRELATION EXPERIMENTS
H. W. Schmitt, J. N. Neiler (Oak Ridge Technical Enterprises Corp., Tenn.), and F. J. Walter *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 129–131 refs (See N65-26475 15-24) CFSTI: $6.00

An accurate absolute energy calibration for semiconductor detectors for fission fragments was developed. This development was possible through a series of experiments with fission fragments and with heavy ions (Br^{79}, Br^{81}, and I^{127}) accelerated in a Van de Graaff accelerator, together with a measurement of correlated energies and velocities of the heavy ions and Cf^{252} spontaneous fission fragments. The energy correlation data can now be analyzed with a proper absolute energy calibration. The experiments are briefly reviewed, the present analysis procedures are outlined, and the results for Cf^{252} spontaneous fission and U^{235} thermal-neutron fission are presented. Also, the apparatus used in these experiments is described together with a schematic diagram of source and detector arrangement and block diagram of the electronic equipment for fission-fragment energy correlation experiments. E.E.B.

N65-26504 Oak Ridge National Lab., Tenn.
CORRELATED FRAGMENT ENERGY MEASUREMENTS AND MASS-vs-ANGLE CORRELATIONS IN ^{226}Ra + p FISSION
H. W. Schmitt, J. W. T. Dabbs, and P. D. Miller *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 140–146 refs (See N65-26475 15-24) CFSTI: $6.00

The kinetics of proton-induced fission of Ra^{226} was studied in detail. The excitation energy of the compound nucleus Ac^{227} is sufficiently low so the probability for second-chance (p, nf) fission is much reduced with respect to that for first-chance (p, f) fission. Thus the kinetic energies, mass distributions, etc., should be characteristic of first-chance fission principally, and in addition, a search for any appreciable correlation between the mass distribution and angle of emission of the fragments might be meaningful. Detailed fragment-energy-correlation measurements were conducted for fragments emitted at a center-of-mass angle of 90° with respect to the incident proton beam for proton energies of 11.0, 12.0, and 13.5 MeV. In the search for a mass-angle correlation, measurements were carried out for energies of 13.5 MeV at center-of-mass angles of 30°, 40°, 60°, and 90°. E.E.B.

N65-26505 Oak Ridge National Lab., Tenn.
WAVE FUNCTIONS FOR MUON CAPTURE IN HYDROGEN μ-MOLECULAR IONS
R. L. Becker and M. R. Patterson *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 150–151 refs (See N65-26475 15-24) CFSTI: $6.00

The determination of the coupling constants for muon capture $p + \mu^- \rightarrow n + \nu_\mu$, in liquid hydrogen is subject to an uncertainty in the probability γ of finding the muon at a proton in the $p\mu p$ molecule. Previous calculations of γ have an estimated uncertainty of 10% since they are based on the adiabatic wave function which includes only first-order corrections to the Born-Oppenheimer approximation (BOA). A calculation of more accurate wave functions, the first step of which is the computation of exact BO muonic wave functions was previously reported. The expansion parameter for the corrections to the BOA is $\epsilon = 4m_\mu/(2M + m_\mu)$ for homonuclear molecules, where M is the mass of the nucleus (p, d, or t). For $pp\mu$, $\epsilon \approx 2/9$. The first-order correction to the BO static potential was calculated from the exact BO wave functions, and energy eigenvalues and wave functions were obtained for the low-lying states of nuclear motion in the adiabatic potential. E.E.B.

N65-26506 Oak Ridge National Lab., Tenn.
SEARCH FOR HYPERFRAGMENTS IN THE Σ^- + He REACTION
H. O. Cohn and W. M. Bugg (Tenn. Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 152–153 (See N65-26475 15-24) CFSTI: $6.00

Film from a slow K^- exposure in a bubble chamber was scanned in search of hyperfragments formed by slow Σ^- interactions. Over 400 candidates for interactions were examined. Only events that could definitely be classed as genuine Σ^- + He interactions were considered. This reduced the sample to 370 events. A considerable fraction of these events have a π^+ at the first vertex but no discernable π^-, thus guaranteeing that a Σ^- was indeed involved in the reaction. Five events were found that can be identified as hydrogen fragments. When corrections are applied, this number is increased to seven. Hence, it was concluded that 2% of all Σ^- + He interactions result in hydrogen hyperfragments. A search for neutron hyperfragments revealed no evidence for these hyperfragments. E.E.B.

N65-26507 Oak Ridge National Lab., Tenn.
EXCHANGE MECHANISM FOR ω PRODUCTION IN π^+–n INTERACTIONS
H. O. Cohn, W. M. Bugg, and G. T. Condo (Tenn. Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 153–155 refs (See N65-26475 15-24) CFSTI: $6.00

Approximately 2800 events of the type $\pi^+ + d \rightarrow (p) + p + \pi^- + \pi^0$ were analyzed from 3.25 BeV/c π mesons incident on the 20-inch deuterium bubble chamber. These events arise from two topologies: 4-prong events and 3-prong events where the spectator proton does not leave a visible recoil in the chamber. All events were required to have at least one proton identifiable by ionization which delimits the discussion to momentum transfers $\leq 50\ m_\pi^2$. The Chew-Low plots for the 3 events are shown as well as the 2800 2π events from the reaction $\pi^+ + d \rightarrow (p) + p + \pi^+ + \pi^-$. The narrow ω band at $m^2_{3\pi} = 0.6$ BeVis clearly resolved and shows that ω production is present at much higher momentum transfer than is ρ production. Also, the plots indicate the presence of the ν mesons as well as a 3π resonance in the mass region of the $A_2(1310)$. The decay angular distributions for the decay of the ω are also given. E.E.B.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-26573# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENT OF THE SPECTRUM OF IONIZED AND NEUTRAL DENSITY FLUCTUATIONS IN A THERMALLY PRODUCED TURBULENT PLASMA, PART II
H. Guthart, D. E. Weissman, and T. Morita Apr. 1965 51 p refs
(Contract ARPA SD-103)
(TR-25; AD-462495)

An experimental diagnostic program is described that studies the spectral distribution of the charged and neutral particles in a weakly ionized, thermally produced, turbulent flow. The power spectral density function (as well as the correlation coefficient) was measured for ions, electrons, and neutrals using an electrostatic ion probe, a microwave electron probe, and a laser transmission experiment. The results indicate that the spectra of all the particles in the turbulent

plasma are identical. The measurements at a Reynolds number of 3000 show that in the initial stage of decay, the bulk of the turbulent energy in the electron density fluctuations lies in a frequency range in which the power spectral density can be approximated by the relation $F(f) = F(0)\ (1 + c^2f^2)^{-1}$, where f is the frequency. This spectrum corresponds to an exponential autocorrelation function with a longitudinal integral scale, Λ, equal to $c/2\pi U$, where U is the mean axial velocity. Author

N65-25622# Princeton Univ., N. J. Plasma Physics Lab.
[PLASMA PHYSICS] Annual Report, 1 Jan.–31 Dec. 1964
Apr. 1965 405 p refs
(Contract AT(30-1)-1238)
(MATT-Q-22)

Application of ion-cyclotron resonance heating in the stellarator effectively heated the plasma. The optimum conditions for wave generation and absorption were close to theoretical predictions. Both the neutron counts and the diamagnetic pressure in the mirror section decayed after the ICRH pulse, and the ion cooling time corresponded to values from cooling by electron-ion collisions. Absolute measurements of line intensities on ohmically heated discharges in helium gas, as well as measured confinement times of low-density and low-temperature plasma, were consistent with the Bohm formula. Theoretical considerations of hydromagnetic instabilities led to the development of systems based on multipolar helical windings, which may be applied to stellarators. Experiments with cesium and barium plasmas established the validity of the equilibrium model in cesium plasma work; connected various modes of low-frequency oscillation with the decreasing curvature of a plasma; confirmed the reduction of damping of ion acoustic waves by distance; identified variations of low-frequency oscillations with plasma length and field strength; found close agreement between the emission of microwave radiation by a cesium plasma and the theory; and confirmed the skewed axial temperature distribution in a barium plasma by spectroscopy. A variety of other studies are also reported. G.G.

N65-25684# American Meteorological Society, Boston, Mass.
SIMULATION OF PARTICLE MOTION IN INTERSECTING ELECTRIC AND MAGNETIC FIELDS [MODELIROVANIE DVIZHENIIA CHASTITS V PEREKRESH-CHIVAIUSH-CHIKHSIA ELEKTRICHESKOM I MAGNITNOM POLIAKH]
N. V. Trikhanova and P. M. Shchanin Feb. 1965 11 p refs
Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 3, 1964 p 3–6
(Contract AF 19(628)-3880)
(T-R-450; AD-613980)

The motion of particles in intersecting electric and magnetic fields that vary in the direction of movement of the particles is simulated. The trajectories of particles with different initial conditions at the input are given. Author

N65-25845# General Electric Co., Schenectady, N. Y. Research Lab.
IONIZATION AND RECOMBINATION IN CESIUM-SEEDED PLASMAS NEAR THERMAL EQUILIBRIUM
L. P. Harris Jun. 1964 27 p refs
(Rept.-64-RL-3698G)

Measurements were made of electron-density relaxation in cesium-seeded plasmas perturbed from thermal equilibrium at temperatures from 1500° to 2000° K. The gases consisted of 0.1 to 20 torr Cs vapor in atmospheric pressure argon or helium. Electron densities ranged over 1.9×10^{11} to 3.8×10^{13} cm^{-3} and relaxation times over 30×10^{-6} to 50×10^{-3} second. An analysis developed relates the measured relaxation times to the rate constants for the electron production and loss processes in the plasma. Results indicate that charge production and loss are dominated by the atomic–ion process $Cs + e + 3.89\ eV \leftrightarrow Cs^+ + 2e$ at higher temperatures, and by the molecular–ion process $Cs + Cs + 2.82\ eV \leftrightarrow Cs_2^+ + e$ at lower temperatures and higher cesium pressures. At the lower temperatures and cesium pressures, dominant process is ambipolar diffusion. Results obtained when the atomic–ion process dominates agree with calculations based on the equilibrium properties of the gas and recent theory for two-electron, three-body recombination. The rate of the molecular–ion process corresponds to a two-body recombination coefficient of approximately 1×10^{-8} cm^3/sec at temperatures of 1250° to 1400° C, a value small relative to that derived from earlier experiments. Evidence indicates that argon and helium atoms play no significant roles beyond those of thermal bath and diffusion barrier. Author

N65-25865# Bologna Univ. (Italy).
GROUND STATE OF AN ELECTRON GAS IN A MAGNETIC FIELD
V. Celli and N. D. Mermin (Cornell Univ., Ithaca) Apr. 1965 61 p refs
(Contract Nonr-401(38))
(TR-4; AD-614254)

The ground state of an electron gas in a uniform magnetic field is found to be one in which a spin density wave exists, directed along the field. This conclusion is reached through what is essentially a Hartree–Fock calculation with a repulsive interaction, but in which no restrictive assumptions are made about either the strength or the range of the exchange interaction. Thus static screening does not eliminate the spin density wave in the presence of a magnetic field, as it does in the electron gas when no magnetic field is present. The temperature at which the transition to a spin density wave state occurs approaches zero as the field vanishes. The pertinent question is whether there is a range of field strengths and electronic densities for which the transition temperature is observably high. It is found that spin density wave formation is most favorable when only a few Landau levels are occupied, corresponding to large field strengths and low electronic densities. A rough calculation indicates that in InSb a transition temperature as high as 10 millidegrees can be realized. Author

N65-25898# Innsbruck Univ. (Austria). Inst. for Theoretical Physics
MAGNETOGASDYNAMIC WAVES OF SMALL AMPLITUDE
F. Cap and Helmut Friedel 14 Jul. 1964 15 p refs
(Contract AF 61(052)-675)
(SR-12; AD-613621)

Since characteristics are important for solving magnetogasdynamic equations and since magnetogasdynamic waves propagate along them, publications on the propagation of plasma waves were studied. The complete MGD basic equations were taken into consideration. The basic equations will be solved by two essentially different methods: (1) on linearized equations, the propagation of plane waves being studied in a medium at rest; (2) examination of perturbations of a more general type, applying the theory of characteristics. If both methods yield consistent results, the existence of fast and slow magnetoacoustic waves can be proved. Author

N65-25899# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
AMPLIFICATION OF HYDROMAGNETIC WAVES IN THE MAGNETOSPHERE BY A CYCLOTRON INSTABILITY PROCESS WITH APPLICATIONS TO THE THEORY OF HYDROMAGNETIC WHISTLERS
T. Watanabe and J. A. Jacobs (British Columbia Univ.) Jan 1965 77 p refs
(Contract Nonr-3116(00))
(DI-82-0398; AD-612771)

A study of cyclotron instabilities which occur in magnetospheric hydromagnetic waves coupled with a stream of either electrons or protons, is reported. Results of an analysis of the physical nature of cyclotron instabilities, which is based upon the general theory of growing waves; and an analysis of the applicability of the theory of cyclotron instability to hm (hydromagnetic) whistlers, are included. Included are calculations of the bounce period of an hm wave packet between magnetically conjugate points. S.C.W.

N65-25914# Braddock, Dunn and McDonald, Inc., El Paso, Tex.
INVESTIGATION OF THE STATISTICS OF BREAKDOWN USING NANOSECOND PULSE TECHNIQUES Final Report
D. F. Mc Donald, C. J. Benning, and S. J. Brient Griffiss AFB, N. Y., RADC, Mar. 1965 55 p refs
(Contract AF 30(602)-2781)
(RADC-TR-64-584; AD-614286)

The experimental equipment, experimental procedures, and test results of a laboratory study of the statistics of discharge initiation in highly over-volted planar spark gaps is presented. The theory of operation of a subnanosecond rise-time multikilovolt pulse generator developed for the study is described. Test data on the electron emission of different electrode materials as a function of gap field strength and electrode conditioning is presented. In addition, a simplified model of the statistics of free-space breakdown in a transmitted microwave beam is developed. Author

N65-25997# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
A STUDY OF ELECTROMAGNETIC WAVES IN A CIRCULAR PLASMA COLUMN
Paul O. Berrett and Curtis C. Johnson May 1965 170 p refs
(Grants NSF G-15017; NSF GP-843; NSF GK-29)
(NSF-8)

Electromagnetic waves in a circular plasma column with axial static magnetic field are investigated. The analytic approach to find the mode solutions treats the plasma as a medium having a tensor permittivity and introduces the boundary conditions as impedances at the column's lateral surface. It is found that, in general, the modes are hybrid and the usual separation into transverse electric and transverse magnetic modes is not possible. Solutions are found by solving the determinantal equation by numerical methods on a high-speed digital computer. Experimental measurements on a thermally generated cesium plasma column and on a mercury discharge plasma column are reported. Author

N65-26001# Maryland Univ., College Park. Dept. of Physics and Astronomy
STATUS REPORT, 1 DEC. 1964–28 FEB. 1965
Hans R. Griem [1965] 7 p refs
(Contract Nonr-595(10))
(AD-612615)

Progress on the measurement of Stark broadening of lines from light elements; measurement of the ultraviolet radiation from shock heated plasmas; collisionless plasma shock waves; plasma diagnostics by light scattering; resonance broadening by atom–atom impacts, and wing broadening of Lyman-alpha by electrons and ions are discussed. The N-II 3994 Å and 3437 Å lines were studied in a plasma containing 90% hydrogen and 10% nitrogen. Also, the determination of the f-value of the next higher series member He-I 537 Å was studied. Further, a Q-switched laser produced pulses of about 6 megawatt peak power and containing about 0.3 joules energy. E.E.B.

N65-26019# Los Alamos Scientific Lab., N. Mex.
LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Semiannual Status Report, Period Ending Apr. 30, 1965
May 1965 110 p refs
(Contract W-7405-ENG-36)
(LA-3320-MS) CFSTI: $4.00

Present and future activities of the thermonuclear research program are outlined with emphasis on the pulsed high density approach to fusion power. The Scylla θ pinch yielded high values for density, temperature, and confinement time. A d-t reactor having a T multiplying blanket inside the coil system produced holding power for 1 to 5 msecs. Levitation of closed magnetic bottles with caulked cusps resulted in plasma depositions on the surface of the ring. Cooling of the systems to liquid N_2 temperatures was considered, but the apparent manifestation of finite Larmor radius stabilization at high β and the general success of the Scylla pulsed high density approach were found more promising. A schlieren investigation with a pulse of 6943 Å light from a ruby laser supported the plasma density value in the dense plasma focus of about 10^{19} ion/cm^3 computed on the assumption that the neutrons from it are produced by a Maxwellized thermonuclear reaction. Application of the He–Ne beam interferometer in the crossing of a transverse magnetic field confirmed the nonspreading of the energetic plasma component of the beam. G.G.

N65-26038# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics
EXPERIMENTAL STUDY OF THE FLOW OF A MAGNETIZED PLASMA THROUGH A MAGNETIC DIPOLE FIELD
L. Danielsson and L. Lindberg *In* Arkiv för Fysik, v. 28, no. 1, 1965 17 p refs Available from Almqvist & Wiksell, Stockholm: 50 Swedish Kr.

In a model experiment a plasma is shot towards a magnetic dipole to simulate the interaction between the solar wind and the earth's magnetic field. The interaction is studied by means of electric and magnetic probes and Kerr-cell photography. It is found that the plasma penetrates deep into the dipole field. However, at the same time the electric field is substantially reduced in the vicinity of the dipole. Author

N65-26049*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF TWO DIRECT-CURRENT METHODS OF PLASMA PRODUCTION FOR USE IN MAGNETIC MIRROR EXPERIMENTS
Roman Krawec, George M. Prok, and Clyde C. Swett Washington, NASA, Jun. 1965 28 p refs
(NASA-TN-D-2862) CFSTI: HC $2.00/MF $0.50 CSCL 20I

An experimental investigation of two methods for producing a hydrogen plasma was conducted. One of the two methods was a hot-cathode discharge, while the other was a modified

Philips-ionization-gage (PIG) discharge. The plasma properties investigated were ion diffusion, electron density, electron temperature, mean electron energy, plasma potential, and plasma current profile. The modified PIG discharge produced too small a plasma column to be satisfactory. It was possible with the other sources to form a 5-centimeter-diameter plasma column having a density of 8.5×10^{11} electrons per cubic centimeter at a pressure of 2 microns and a discharge supply current density of 15 amperes. The electron density is shown to be a function of current density and is compared with the results of other investigators. The configuration having the filament negative with respect to the plasma chamber minimized ion diffusion. The thermal electron temperatures as measured by the Langmuir probe were 2.3 to 8.4 electron volts; the temperatures of the primary electrons as measured by the spectrometer were 23 to 55 electron volts. Author

N65-26050# Hughes Research Labs., Malibu, Calif.
SCATTERING OF RADIATION BY PLASMAS. PART I: QUANTUM MECHANICAL CALCULATION OF SCATTERING CROSS SECTIONS
D. F. DuBois and V. Gilinsky (RAND Corp.) Nov. 1963 32 p Submitted for Publication
(RR-290; HD-460966, Pt. I)

The quantum electrodynamics of the scattering of radiation from an interacting, fully ionized plasma is treated. The theory includes the effects of quantum statistics and is valid to all orders in many-particle perturbation theory. The scattering cross section is related to the partial conductivities of the interacting system. This reduces the problem of the inclusion of close Coulomb collisions, which lie outside previous RPA calculations, to the calculation of collision corrected conductivities. The theory is applicable to degenerate quantum plasmas as well as to classical plasmas. Author

N65-26059# General Applied Science Labs., Inc., Westbury, N. Y.
STEADY STATE DIFFUSION OF CHARGED SPECIES IN A PARTIALLY IONIZED MEDIUM
F. Lane 14 Aug. 1964 41 p refs
(Contract NOw-63-0637-c FBM)
(TR-457; AD-460902)

A study designed to determine the effects of the charge induced electric field upon the diffusion of the charged species due to gradients in their own number densities, and possibly other charged species, is reported. Presented is a theoretical analysis which was developed for the diffusion of charged species (electrons, positive ions, and negative ions) in a non-uniform medium composed chiefly of neutral species and a much smaller number density of charged species. Results of a comparative study on the effect of determined diffusion coefficients and cross diffusion coefficients on computed electron density, are discussed. The object of the comparison was to determine the electron density distributions (dependence of n_e upon radius) at several axial locations in the wake downstream of a slender cone base of one foot radius, but upstream of the point of transition from laminar to turbulent flow. Although the initial data was the same for both calculations (radial distributions of species concentrations, pressure, temperature, etc.), the different charged species diffusion models had almost no back reaction upon the basic neutral flow. It is concluded that in each case, the computed neutral flow background is unchanged, and only the charged species distributions differ. S.C.W.

N65-26115# RAND Corp., Santa Monica, Calif.
THE FLOW OF A CONDUCTING GAS JET WITH ALIGNED MAGNETIC FIELD
Stanley A. Berger Mar. 1965 36 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4368-ARPA; AD-614420)

When an infinitely conducting fluid flows under the influence of a magnetic field in such a way that the velocity and magnetic fields are aligned, then the governing equations may formally be reduced to those of ordinary gas dynamics. The equations are still nonlinear, but if one restricts attention to plane flows, then the hodograph technique may be employed. The equations in the hodograph plane are linear and may be solved exactly. The difficulty then remaining is to satisfy the boundary conditions. Only for restricted classes of problems can this be done. This paper treats one such class of problems, the flow of a jet of gas out of a slit in a rectangular channel. The method used is a modification of the original method of Chaplygin for nonconducting gas jets. Author

N65-26134# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF A FLAT LAYER OF IDEALLY-CONDUCTING VISCOUS FLUID IN A LONGITUDINAL MAGNETIC FIELD
G. A. Glonti 26 Mar. 1965 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 6, 1962 p 169–170
(FTD-65-16/1+2; AD-614026)

Hydrodynamic and electromagnetic field equations were used to determine the behavior of a flat layer of ideally-conducting viscous fluid in a longitudinal magnetic field. The dispersion equation for the perturbation frequency in the presence of the longitudinal magnetic field was obtained under the assumption that: (1) the deformation amplitude is small, (2) displacement currents are absent, (3) space charges are absent, and (4) a free surface and steady external pressure exists. A negative value was obtained for the damping factor and it was concluded that the flat fluid layer is unstable in a longitudinal magnetic field. G.G.

N65-26167 AVCO-Everett Research Lab., Everett, Mass.
NUCLEAR PROPULSION SCHEMES USING MAGNETOHYDRODYNAMIC CONVERSION TECHNIQUES
Richard J. Rosa and Thomas R. Brogan *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 286–312 (See N65-26150 15-22) CFSTI: $7.00

The basic principles of the magnetohydrodynamic generator are reviewed. Two advantages of the MHD are that: (1) At a given temperature it can be orders of magnitude greater than the energy per unit area delivered by even blackbody radiation. (2) Wall materials and structures which are transparent to electric power are a great deal easier to find than materials which are transparent to optical electromagnetic frequencies. The point is made that, combining an MHD generator with advanced high-temperature reactors, propulsion systems can be made with performance comparable to, or better than, a gas-core reactor alone. Further, the fuel containment does not have to be solved in order to get this type of performance. E.E.B.

N65-26174# Microwave Associates, Inc., Burlington, Mass.
INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS Quarterly Progress Report, 16 Nov. 1964–15 Feb. 1965
H. S. Maddix and J. Gregory 24 Jun. 1960 42 p refs
(Contract DA-36-039-AMC-00097(E))
(Rept.-9; AD-464165)

A theoretical analysis of thermal desorption of trapped gases following clean-up is presented and compared with experimental results. Good agreement exists between theory and experiment. Methods for determining surface temperature during sorption are also presented. Procedures for reliably extending low temperature gas clean-up measurement capabilities to −75° C are described. Neon sorption data taken in the newly extended low temperature range indicates that the square root sorption rate is linear with reciprocal temperature over the temperature range of 250° C to −75° C. A study of clean-up of an argon-water vapor mixture at a glass-metal window indicates that water vapor is cleaned up more rapidly than argon. Mass spectrometer analysis suggests that the dissociation of the water vapor into hydrogen, and other fragments, with subsequent clean-up of the hydrogen constituent, is a primary mechanism in the process. Author

N65-26260*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEEDING CRITERION FOR NONEQUILIBRIUM MAGNETOHYDRODYNAMIC GENERATORS
Frederic A. Lyman and Eli Reshotko Washington, NASA, Jun. 1965 61 p refs
(NASA-TN-D-2873) CFSTI: HC $3.00/MF $0.75 CSCL 20I

The various consequences of the addition of seed to a carrier gas in a magnetohydrodynamic (MHD) generator are examined. In particular, a criterion is established for determining whether the net effect of seed addition is to augment or decrease the power density in MHD generator channels that use magnetically induced nonequilibrium ionization. The analysis considers the effects of electron-neutral collisions, electron-ion collisions, ion slip, and variation of the electron energy loss factor with seed fraction and seed material. Included in the consideration of ion slip are the effects of seed fraction and seed material on ion-neutral collision frequency and on the relative drifts between seed ions and carrier ions. The presented criterion is based on the determination of a break-even condition; namely, that combination of gas density, magnetic field, and induced voltage for which the power density of the unseeded carrier is neither augmented nor decreased by the addition of seed. The formulation is given in general terms and is applicable for arbitrary combinations of monatomic carrier and seed materials. The criterion may be separately applied to each successive station of a segmented-electrode Faraday generator. Calculations of the break-even condition for various noble carrier gases with alkali seed have been performed and are presented in graphical form. The results indicate that ion slip very strongly affects the break-even conditions. Generally speaking, seeding is desirable, and the most beneficial effects are obtained for heavy seed materials. Author

N65-26262# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Energiewandlung und Elektrische Antriebe
THE EDDY CURRENT LOSSES IN THE CONDUCTING CHANNEL WALLS AND THE SIDE EFFECTS OF THE INDUCTION MHD-GENERATOR [WIRBELSTROMVERLUSTE IN KANALWANDEN UND SEITENVERLUSTE EINES EBENEN ELEKTRODENLOSEN MHD-GENERATORS]
C. Carpetis Jul. 1964 37 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-09; DVL-318) Available from Zentralstelle für Luftfahrtdokumentation und Information (ZLDI), Munich: 9, 60 DM

In this paper the eddy current losses in the conducting channel walls of the induction MHD generator are evaluated. For this purpose the electrical characteristics of the MHD generators must be determined under consideration of the finite width of the channel walls. Further the side effects of the induction MHD generator are by a simple method determined. The side losses are calculated and it is indicated that they could be large if the wave length of the magnetic travelling field is not small in comparison with the width of the channel. Author

N65-26273# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE BOUNDARY LAYER ON A FLAT PLATE IN ANISOTROPIC MAGNETOHYDRODYNAMICS
V. B. Varanov, A. G. Kukilovskiy, and G. A. Lyubimov 30 Mar. 1965 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), No. 1, 1964 p 141–142
(FTD-TT-65-44/1+2; AD-614391)

Since thermal flow due to the Larmor precession of electrons does not disappear at the edge of a boundary layer, a series of equations are presented for calculating the boundary conditions. The temperature at the boundary layer was considered fixed, the problem of perturbation in the external flow of the boundary layer was also considered, and the velocity profile was assumed to coincide with the Blasius profile. Thermal layer calculations were reduced using the Ettingshausen effect. Results for the equation are presented graphically. M.W.R.

N65-26281# Michigan Univ., Ann Arbor. Electron Physics Lab.
INVESTIGATION OF CONVERGENT LAMINAR FLOW IN CROSSED-FIELD GUNS
N. A. Masnari Nov. 1964 57 p
(Contract AF 33(615)-1553)
(TR-80; AD-461983)

An abbreviated version of the Kino short gun has been designed and analyzed. The gun is terminated at a plane where the theoretical average space-charge density is approximately equal to the Brillouin density. The location and thickness of the beam at the exit plane are also matched as closely as possible to the corresponding Brillouin quantities for the given anode-sole region conditions. The theoretical design was subjected to a digital computer analysis. Although the beam configuration was essentially as predicted, the electron trajectories intersected, indicating nonlaminar flow. Modification of the cathode ramp electrodes produced either laminar flow or uniform cathode emission, but not simultaneously. Experimental investigations, which were carried out in a beam analyzer, indicated better than 90 percent transmission to the collector for theoretical operating conditions. The beam profile measurements indicated that the beam entered the anode-sole region with the desired thickness and at approximately the Brillouin beam location. Furthermore, the undulation of the beam in the anode-sole region was minimal when the magnetic field was set at the optimum value. In general, the abbreviated Kino gun was demonstrated to be a good beam-launching system for cross-field injected-beam devices. Author

N65-26310# National Co., Inc., Melrose, Mass.
CESIUM BEAM TUBE STUDIES Final Report, 1 Jul. 1963–1 Aug. 1964
J. George, T. Athanis, P. Crandell, and E. Wunderer [1964] 51 p refs
(Contract DA-36-039-AMC-02367(E))
(Rept.-3; AD-461430)

The project involved investigation of the characteristics of the cesium beam effusion pattern, the microwave structure, and the magnetic fields in a cesium beam tube. The beam effusion and magnetic field characteristics were investigated experimentally. The microwave structure was investigated theoretically. A glass-walled experimental set-up was found to produce somewhat inconsistent effusion pattern measurements, apparently because of electron charge accumulation. This situation was improved by an all-metal experimental set-up, which produced more consistent experimental results. Two types of cesium source were evaluated; one type exhibited superiority, producing higher beam intensity and narrower beam width. A proposed design for an improved microwave structure was developed from analytical considerations. The proposed structure is to be fabricated from molybdenum. Greatly improved relative accuracies in magnetic field measurements were achieved with a null-balancing measurement system. With the data available from such measurements, it now appears possible to design a cesium beam tube with little or no Majorana flop. It should be noted, however, that measurement resolution still presents a problem. Author

N65-26315# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
FREE-BOUND RADIATION FROM NITROGEN, OXYGEN, AND AIR
M. P. Sherman and J. L. Kulander May 1965 44 p refs
(Contract Nonr-4188(00))
(R65SD15; AD-464535)

Photoabsorption cross sections for nitrogen and oxygen atoms are computed using the Method of Burgess and Seaton. Results are presented for the radiative recombination of singly ionized nitrogen and oxygen applicable for equilibrium air, for chemical nonequilibrium with internal equilibrium, and internal nonequilibrium Author

N65-26327# Arkansas Univ., Fayetteville. Plasma Lab.
RESEARCH ON THE INTERACTIONS OF PLASMA FLOW AND MAGNETIC FIELDS Quarterly Progress Report, 15 Aug.–15 Nov. 1964
[1964] 17 p refs
(Contract DA-23-072-AMC-168(Z))
(UAPL-22; AD-461432)

The cooling and electrical systems of the plasma-jet facility were modified for better adaptation to its new location, and studies on the efficiency of the electrical energy transfer to the gas, and on the deterioration of the electrodes were initiated. Calculations on the electrical energy produced by plasma interaction with the magnetic field of a solenoid, and experimental results utilizing a brass ring to simulate the plasma, showed good agreement. An equivalent circuit consisting of an inductance of the field coil in free space in series with a time varying parameter related to the magnetic field-plasma interaction was used to represent an MHD induction generator. Evaluation of the use of alternating magnetic fields and varying plasma flow to generate ac power showed a real power decrease with decrease in plasma conductivity. G.G.

N65-26337# Princeton Univ., N. J. Plasma Physics Lab.
RESISTIVE INSTABILITIES IN A DIFFUSE LINEAR PINCH
B. Coppi, J. M. Greene, and J. L. Johnson Mar. 1965 74 p refs
(Contract AT(30-1)-1238)
(MATT-326)

The effects of small electrical resistivity, viscosity, and thermal conductivity on hydromagnetic instabilities for diffuse linear pinch configurations are considered. For finite-pressure systems a higher order of equations must be solved than in previous work which was applicable to stellarator or slab geometries. A careful treatment of the problem of matching the perturbed solution across the boundaries which separate a resistive layer from outer hydromagnetic regions clarifies the relationship between resistive instabilities and the ordinary hydromagnetic instabilities which are obtained from the ideal equations. In a similar way consideration of various limiting cases brings out the connection between the different resistive modes. The manner in which thermal conductivity and viscosity assert themselves is exhibited, and for a special configuration it is shown explicitly how viscosity can exert a small stabilizing effect. Aside from this, instabilities are found whenever the pressure decreases outward. Author

N65-26339# Princeton Univ., N. J. Plasma Physics Lab.
OPTIMUM GENERATION OF ION CYCLOTRON WAVES IN A CYLINDRICAL TWO-ION PLASMA
K. Chung, M. A. Rothman, R. M. Sinclair, and S. Yoshikawa Jun. 1965 19 p refs
(Contract AT(30-1)-1238)
(MATT-343)

Ion cyclotron waves have been generated in a hydrogen-deuterium plasma (previously formed by Ohmic heating) contained in the Model C stellarator, using an induction coil of finite wavelength. The conditions for optimum generation of waves, found experimentally, were in good agreement with theoretical predictions. Author

N65-26342# Columbia Univ., New York. Plasma Lab.
DIFFUSION MEASUREMENTS IN A FULLY IONIZED CESIUM PLASMA
Bernard J. Eastlund (Ph.D. Thesis) [1964] 170 p refs
(Grant NSF GP-554)
(Rept.-18)

Pulses of potassium plasma were launched at the end of a quiescent, steady state, fully ionized cesium column. The shape of this pulse was measured as it drifted along the cesium column. Values of the diffusion coefficients for both parallel ($D_{\parallel}$) and perpendicular ($D_{\perp}$) diffusion in a magnetic field have been obtained. The experimental values for $D_{\parallel}$ agree very well with the Chapman–Enskog solution of the Boltzmann equation. Experimental values obtained for $D_{\perp}$ do not agree with present theoretical predictions. It is observed that $D_{\perp}$ appears to be inversely proportional to the particle number density, while classical theory predicts direct proportionality. Free molecular flow experiments were carried out and found to agree well with classical kinetic theory. Author

N65-26361# Princeton Univ., N. J. Plasma Physics Lab.
THE RELATIONSHIP BETWEEN RESISTIVE INSTABILITIES AND MICROINSTABILITIES IN INHOMOGENEOUS PLASMAS
T. E. Stringer May 1965 29 p refs
(Contract AT(30-1)-1238)
(MATT-320)

Presented is a rather general equation which gives the modes responsible for microinstabilities in a collision-free plasma, and under certain conditions also the rippling and gravitational resistive instabilities. A table shows the corresponding mode to these two limits, and the corresponding

simple waves in a homogeneous plasma. An appendix contains calculations on the growth rates of resistive instabilities in a cylindrical plasma. G.G.

N65-26445# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
MILLIMETER WAVELENGTH FOCUSED PROBES AND FOCUSED, RESONANT PROBES FOR USE IN STUDYING IONIZED WAKES BEHIND HYPERSONIC VELOCITY PROJECTILES Technical Report
R. I. Primich and R. A. Hayami Jul. 1963 61 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 347-63)
(TR63-217C; AD-413158)

Strongly focused microwave beams are being used as a plasma diagnostics tool in the determination of the magnitude and spatial distribution of ionization behind projectiles fired at hypersonic velocities into the controlled atmosphere of a flight physics range. The importance of millimeter wavelength techniques for this purpose is stressed. The design philosophy of focused plasma probes is outlined and specific details of 35 and 70 Gc probes are given, together with some typical results. The conversion of such a probe into a free-space resonator in which the resolution is preserved, but in which the sensitivity is greatly improved, is discussed and some preliminary results are given. Author

N65-26470# Princeton Univ., N. J. Plasma Physics Lab.
REEMISSION OF IONICALLY PUMPED H_2 AND He FROM A STAINLESS STEEL SURFACE
G. Martin and G. Lewin Mar. 1965 20 p refs
(Contract AT(30-1)-1238)
(MATT-336)

H_2 and He discharges in a stellarator produce copious wall bombardment by the plasma ions. The reemission rate of the gas was measured for times of 0.06 to 10^5 seconds after bombardment. The rate was approximately proportional to $t^{-0.5}$ for He and $t^{-0.75}$ for H_2. The reemission is calculated for a model based on nonuniform initial concentration with diffusion of the gas in the solid. It follows from this model that the rate is proportional to t^{-n} where n approaches 0.5 or 1.5 as the ratio of reemission to bombarding time approaches zero or infinity. The model does not agree with the measurements. Author

N65-26581# Princeton Univ., N. J. Plasma Physics Lab.
MEASUREMENT OF ION CONCENTRATIONS AND ELECTRON TEMPERATURE IN A BARIUM PLASMA
L. C. Johnson, E. Hinnov, and N. Rynn May 1965 23 p refs
(Contract AT(30-1)-1238)
(MATT-327)

SAM X-14 stannous fluoride (20%) solution was tested over a period of 8 weeks as a stock solution for the preparation of topical solutions and prophylaxis pastes. Performance was based upon the ability of the test preparations to prevent in vitro acid decalcification of enamel surfaces. The stock solution maintained its protective potency over the entire experimental period. The most effective treatment was prophylaxis with a paste containing approximately 7% stannous fluoride followed by the topical application of 10% stannous fluoride. This provided a mean protection for the seven age intervals—0, 1, 2, 3, 4, 6, and 8 weeks—of 78.1% Author

N65-26582# Princeton Univ., N. J. Plasma Physics Lab.
THE KELVIN-HELMHOLTZ INSTABILITY IN A FULLY-IONIZED PLASMA IN A MAGNETIC FIELD
Nicola D'Angelo Jun. 1965 11 p refs
(Contract AT(30-1)-1238)
(MATT-337)

In examining the conditions of instability in a fully-ionized plasma immersed in a magnetic field, it is assumed that the streaming velocity of the ions along the magnetic lines changes from point to point, in a direction perpendicular to the magnetic field. As the ratio of particle to magnetic pressure is also assumed to be extremely small, changes in the magnetic field produced by the plasma motion are not considered. A simplified model is used to examine the conditions of instability. The problem is treated by Cartesian geometry, and a series of equations are evolved to indicate where instability occurs. Since effects such as Landau damping and ion viscosity are not considered, it is suggested that the dispersion relation presented may not be a full representation of an actual physical situation as, for example, that related to experiments with thermal cesium plasmas. M.W.R.

N65-26628*# Radio Corp. of America, Princeton, N. J. RCA Labs.
VAPOR-FILLED THERMIONIC CONVERTERS Final Report
K. G. Hernqvist, J. R. Fendley, Jr., and J. D. Levine Washington, NASA, Apr. 1965 48 p refs
(Contract NAS3-4173)
(NASA-CR-54421) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Theoretical studies necessary for interpreting experimental conductivity data of cesium on insulators have been completed. Starting from the Schrödinger equation for a single adsorbed cesium atom, wave functions and their properties have been compiled. This information and Kopineck's integrals are used to compute the tunneling (resonance) energy between two adsorbed cesium atoms which is then generalized to an entire array of adsorbed cesium atoms. One of the most important consequences of the theory is that, to a first approximation, conductivity should be proportional to the cesium pressure squared. The experimental data verify this and also verify other anticipated dependences on dielectric constant and surface contamination. The cesium adsorption heat on clean alumina and Pyrex surfaces is calculated to be 0.85 eV; and the large configurational entropy term, $\Delta s/k \approx 6$, seems to indicate a long-range order in agreement with certain low-energy electron diffraction (LEED) studies. Data obtained under contaminated conditions have shown that adsorbed hydrogen causes the conductivity to increase following a 2/3-power law, while leaving the cesium adsorption heat invariant. Various measurements of arc drop and anode work function are reported. Arc drop is found to be nearly 0.5 volt for cathode temperature in the range 1300 to 1500° K and current density of 6 to 12 A/cm^2. Anode work function with a high cesium coverage has been found to be equal to or greater than 1.93 V. A method is described for measuring the work function of metal surfaces coated with adsorbed cesium or with a combination of cesium and oxygen. An analysis of the effects of reverse currents in thermionic converters is presented. It is shown that reverse currents cause a contribution to the arc drop and also impose limiting conditions on the useful range of anode work functions. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-25586# Gt. Brit. Ministry of Aviation, Mottingham. Technical Information and Library Services
THE METHOD OF GROUPS IN THE QUANTUM PHYSICS OF A SOLID BODY (POINT SYMMETRY) [METOD TEORII GRUPP v KYANTOVOI FIZIKE TVERDOGO TELA]
A. V. Sokolov and V. P. Shirokovskii Apr. 1965 65 p Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 60, no. 4, 1956 p 617–688
(TJL/T-5575)

General principles of analysis of quantum mechanics systems are presented and the value of group theory demonstrated. Symmetric properties of systems should be used to derive generalized methods for complex quantum mechanics systems. The problems particularly considered are determination of the electron states of a system, splitting of atomic terms in a field of predetermined symmetry, and selection rules for quantum transitions in a crystal. Author Author

N65-25593*# Old Dominion Coll., Norfolk, Va. Dept. of Physics
DEFECT ANNEALING IN IRRADIATED SEMICONDUCTORS Progress Report No. 2, Oct. 1, 1964–Mar. 31, 1965
W. Maurice Pritchard 1 Apr. 1965 13 p ref
(Grant NsG-602)
(NASA-CR-63253) CFSTI: HC $1.00/MF $0.50 CSCL 20

Developments in a research program on defect annealing in irradiated semiconductors are presented. The annealing model was extended to include an arbitrarily large number of secondary defect complexes. Series solutions were made for the isothermal annealing equations with any number of secondary defect complexes. Computer calculations and data analysis were made to evaluate the behavior of the kinetic annealing model with one secondary defect complex. R.N.A.

N65-25621# Illinois Univ., Urbana, Dept. of Physics
FERROMAGNETISM IN THE TRANSITION METALS
J. L. Beeby [1965] 45 p refs
(Contract Nonr-1834(12))
(AD-613977)

A proposed theory for the behavior of the electrons in transition metals is outlined. Corrections to the Hartree–Fock theory are necessary when electrons having very similar wave functions are at a given ionic site, and the correction forms are given. The introduction of the corrections in this case leads to an itinerant-electron-like theory of ferromagnetism. Author

N65-25637# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
MICROSCOPIC THEORY OF IONIC DIELECTRICS
Robert Englman 1 Nov. 1964 72 p refs
(Contract AF 61(052)-253)
(SR-2; AD-612613)

A careful treatment of the Schrödinger equation, including the electron-phonon interaction, for ionic solids leads to the clarification of existing concepts and to the derivation of new results. The work covers the thermodynamic properties, the ordinary dielectric behavior and the ferroelectric phase of ionic dielectrics. Author

N65-25638# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research
MOSSBAUER STUDIES ON IRON IN THE PEROVSKITES $La_{1-x}Sr_xFeO_3$ ($0 \leq x \leq 1$). CONDITION FOR MAXIMUM RESONANCE ABSORPTION PEAK IN A SINGLE-LINE MOSSBAUER ABSORBER
Uri Shimony and Jens M. Knudsen Feb. 1965 49 p refs (Contract Nonr-1841(10))
(TR-196; TR-197; AD-613577) CFSTI: HC $2.00/MF $0.50

Mössbauer spectra of the perovskite series $La_{1-x}Sr_xFeO_y$ ($0.0 \leq x \leq 1.0$; $y \gtrsim 3$) were obtained with ^{57}Fe as the photon-emitting and absorbing nucleus and analyzed in detail. The Néel temperature of antiferromagnetic $LaFeO_3$ decreases with increasing Sr concentration, in agreement with previous reports. That of antiferromagnetic $SrFeO_{2.5}$ (brownmillerite structure) also decreases as oxygen is introduced to transform it to perovskite $SrFeO_3$. Characteristic Fe^{4+} lines, identified for compounds of high x, have isomer shifts between +0.10 and +0.20 mm/sec relative to a source of ^{57}Co in stainless steel Type 310. However, spectra of compounds of intermediate x indicate the existence of an intermediate Fe^{3+-4+} state, and a correlation between the total isomer shift of a compound and its Fe^{4+} content was attempted. With increasing x a significant discontinuity in the total isomer shift, corresponding to a transition from magnetic order to disorder, was found. Line widths vary around 0.40 mm/sec (compared with 0.26 mm/sec, the narrowest line obtainable in the present setup) and show broadening in a sample fired for a short time. The temperature effect was used to calculate the specific heat. Author

N65-25640# Centro Atomico Bariloche (Argentina).
THE MECHANISM OF WORK-HARDENING IN F.C.C. SINGLE CRYSTALS
Gunther Schoek (Univ. Cuyo) Feb. 1965 12 p refs
(Grant DA-ARO-49-092-64-G27)
(AD-613320)

Various theories on work-hardening in crystals are examined and critical analyses of several are given. The most successful theory is considered to be one based on electron microscope observations of the crystal surface, which indicate that dislocation pile-ups in the interior of the crystal cause hardening due to the long range stress field. Experimental work centered on obtaining round single crystal seeds and plates of Cu and Al, and special furnaces for growing the crystals under vacuum or argon atmosphere were built. A cold chamber for deformation between liquid air temperature and room temperature was also constructed. Preliminary results show that (1) at room temperature, the stress to deform crystals with edge orientation is higher than the stress to deform crystals with screw orientation; and (2) aluminum crystals grown in argon atmosphere have a lower critical resolved shear stress than crystals grown in air. M.G.J.

N65-25674# Army Engineer Research and Development Labs., Fort Belvoir, Va.
GROWTH OF SINGLE-CRYSTAL NEMATIC FILMS [ROST MONOKRISTAL'NYKH NEMATICHESKIKH PLENOK]
I. G. Chistyakov [1965] 12 p refs Transl. into ENGLISH from Tr. Inst. Kristallogr., Akad. Nauk SSSR, v. 4, 1964 p 74–80
(ERDL-T-1781-65; AD-613984)

The formation mechanisms of disinclinations were investigated in a study to determine the growth characteristics single liquid crystal nematic films. Volume and surface disinclinations are distinguished and their formation discussed. Crystal growth processes for normally and longitudinally orientated nematic films are described and microcinematographs are included. R.N.A.

N65-25688# American Optical Co., Southbridge, Mass. Research Div.
NEODYMIUM LASER GLASS IMPROVEMENT PROGRAM Technical Summary Report, 30 Jun. 1964–1 Jan. 1965
Richard F. Woodcock Apr. 1965 17 p refs
(Contract Nonr-3835(00); ARPA Order 306-64; Proj. Defender)
(TSR-5; AD-613983)

The birefringence effects of various oxides used in making glass were studied to determine their feasibility in developing other zero stress-birefringence glasses to be used for neodymium laser glass. A series of glass compositions of both Pockels type and non-Pockels type glasses were examined for their thermal coefficient of the index of refraction, their coefficient of thermal expansion, and their stress-optical coefficient. The observed data are being analyzed. It was felt, that an athermalized laser system can be produced by counterbalancing the index of refraction changes produced by stress with index changes produced by temperature directly. G.G.

N65-25689# Rochester Univ., N. Y. Inst. of Optics
OPTICAL PROPERTIES OF SOLID RARE GASES AND THEIR ALLOYS
G. Baldini Aug. 1964 19 p refs Presented at the Spring Meeting of the Am. Phys. Soc., Philadelphia, 1964
(Grant AF-AFOSR-236-63)
(AD-612715)

Excitation of the stabilized, solid, rare gases krypton, xenon, and argon by radiation of the proper wave length led to the optical population of their empty band levels and increased the electrical conductivity of these insulators. Theoretical evaluations of the excited states of the solid rare gases by the Wannier model that interprets the exciton as an electron-hole pair where the electron travels in the conduction band and the hole in the valence band, were not completely satisfactory for the n = 1 states, but described very well the higher states. This model makes it possible to derive from optical spectra the reduced masses of an exciton and sometimes also the effective mass of an electron in the conduction band. It was concluded that the Wannier model provides a description which is complimentary to the Frenkel model that is based on the assumption of atom interaction in the lattice. A table presents the excitation parameters for the investigated solid rare gases. G.G.

N65-25697# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics
SPIN RESONANCE IN SOLIDS Final Report
Donald F. Holcomb 26 Mar. 1965 14 p refs
(Contract Nonr-401(15))
(AD-613520)

A review of developments on spin resonance in solids is presented. A high-power pulsed rf spectrometer with phase coherent detection, spin lattice relaxation processes in solids, the characteristics of a heavily saturated spin system, color centers in ionic crystals, and nonmetal to metal transition are discussed. R.N.A.

N65-25738# Syracuse Univ. Research Inst., N. Y.
INTERACTIONS OF ATOMS AND MOLECULES WITH SOLID SURFACES Annual (Status) Report, 1 Oct. 1963–30 Sep. 1964
John W. Trischka [1964] 7 p
(Contract Nonr-669(09))
(AD-613310)

Both Pt–W and Pt surfaces were studied by observations of electronic thermionic emission and positive ion emission. Under certain conditions, the wires of both metals can ionize K atoms, but not the K atom bound to a halogen in an alkali halide vapor. This discriminating property was produced for Pt–W surfaces at pressures near 10^{-10} mm Hg, demonstrating that the property is inherent in the surface rather than in the effect produced by ambient gas in the vacuum. To determine if Ni wires could be used to discriminate between alkali metals and their halides, the electron emission of these wires was measured after exposure to O_2, butane, and ethylene. The last two gases produced discriminating surfaces on Pt–W but O_2 removed the surface. Electron emission of Ni was unchanged after exposure to these gases; in Pt–W, emissions rose sharply after exposure of the heated wire to butane and ethylene and dropped with O_2 exposure. Here, pressures about 10^{-9} to 10^{-8} mm of Hg were used. A beam of Cs atoms was detected by the use of simultaneous Cs and KCl molecular beams on a discriminating Pt–W wire. For a rough measurement of temperature of the Pt–W wires, a silicon solar cell was used to detect the light intensity from the filament; an optical pyrometer was used for more precise measurements. M.W.R.

N65-25739# California Univ., La Jolla. Dept. of Physics
ANNIHILATION OF POSITRONS IN METALS
Chanchal Kumar Majumdar (Ph.D. Thesis) 1965 304 p refs
(Contract Nonr-2216(11))
(TR-29; AD-613582)

The theory of positron annihilation in metals, including electron–positron and electron–electron interaction, is discussed. It is well-known that the Coulomb force of the positron causes very major changes in the motion of the electrons. Nevertheless, it is established that a sharp 'break' in the angular correlation curve of the two γ-rays resulting from singlet state annihilation occurs at precisely those angles where it should be expected in the absence of electron–positron interaction. This makes positron annihilation in metals a useful tool for the investigation of the true Fermi surface. Taking advantage of such a break in the angular correlation curve, we propose a simple experiment to measure the effective mass of the positron in metals. The experiment consists in a study of the temperature dependence of the angular correlation curve. It is found that an electron–positron bound state or a positronium-like state does not exist in metals. A more general result is derived: in a non-interacting electron gas in the presence of a localised external potential, there is no sharp distinction between bound and unbound states. Author

N65-25743# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
GENERALIZATION OF THE LYDDANE-SACAS-TELLER RELATION
Robert Englman 15 Aug. 1964 9 p refs
(Contract AF 61(052)-753)
(SR-1, AD-612612)

We have obtained the formula $\epsilon(0)/\epsilon(\infty) = \Sigma_j(A_j/w_{jT}^2)/\Sigma_j(B_j/w_{jL}^2)$ for the dielectric constant $\epsilon(w)$, in terms of the long wavelength transverse and longitudinal frequencies, w_{jT} and w_{jL}, of the optical mode j, and of the percentages, A_j and B_j, of the j'th mode in the resolution of the ionic polarization operator $\sum_n Z_n X_n$ (Z_n.X_n being the charge and the displacement of the n'th ion in the lattice) for a thin needle and a slab respectively. The formula is justified in face of other results in the literature. Author

N65-25745# Boeing Scientific Research Labs., Seattle, Wash.
THE FERROELECTRIC AND STRUCTURAL PROPERTIES OF HAFNIUM OXIDE COMPOUNDS
Eleanor Greene Christensen Sep. 1964 46 p refs
(DI-82-0377; AD-613589)

The ferroelectric and structural properties of HfO_2 compounds, using high purity (99.9%) HfO_2 were investigated. Solid solutions of $CaHfO_3$, $SrHfO_3$, and (Pb,Ba)HfO_3 were studied. Dielectric measurements were made between room temperature and 300° C. Hysteresis loop measurements were made at liquid nitrogen temperature, room temperature, and at approximately 120° C. The compositions and crystalline structures formed were identified by X-ray diffraction techniques. Author

N65-25786# Pennsylvania Univ., Philadelphia. Dept. of Physics
MAGNETIZATION OF SPIN IMPURITIES IN FERROMAGNETS
H. Callen, D. Hone, and A. Heeger Feb. 1965 11 p refs
(Contract Nonr-551(36))
(TR-21; AD-612473)

Direct calculation was made of the spectral weight function of impurity ion excitation, using equations of motion of the two-time temperature-dependent Green functions in a random phase approximation. It was found that the impurity magnetization obeys the molecular field theory more accurately than does the host. For a weakly-coupled impurity, the spin wavelength is perturbed downward in the vicinity of an impurity, little scattering occurs at the top of the band, and the high kinetic energy reduces amplitude on the impurity. The effective coupling constant depends on the impurity exchange coupling rather than on the host exchange, as in the case of the strongly-coupled impurity where the spin wave band energy raises upward to the vicinity of the impurity. In this case, as the energy increases and wavelength decreases, the spin waves become strongly scattered and have small amplitude on the impurity. At the top of the band, the spin waves are energetic enough to pass over the impurity. Here, excitation energy of the impurity roughly equals the energy at the top of the spin wave band of the host lattice. M.W.R.

N65-25799# Systems, Inc., Orlando, Fla.
PEM FOR FILTERS, UPPER SIDEBAND (1.75 MC), QUARTZ CRYSTALS TYPE EL-FR (X-1) Quarterly Progress Report, 30 Sep.–31 Dec. 1964
[1964] 25 p
(Contract DA-36-039-AMC-03636(E))
(QPR-2; AD-612603)

The computed response characteristics of the 12 crystal designs are presented. Both crystal and coil loss factors are included in the computations and their relative effects are evaluated. Crystal design is discussed and characteristics of the initial group of crystals are described. Author

N65-25846# Los Alamos Scientific Lab., N. Mex.
AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. V: GENERAL LEAST SQUARES REFINEMENT
Don T. Cromer, R. B. Roof, Jr., and Allen C. Larson 17 May 1965 111 p refs
(Contract W-7405-ENG-36)
(LA-3259) CFSTI: $4.00

Procedures employed and computer program used for determining the positions and thermal motions (isotropic and/or anisotropic) of the atoms in a single crystal are described. The basic technique involves an iterative least-squares procedure. A special feature of this program is the inclusion of a secondary-extinction correction as a least-squares parameter. Author

N65-25901# Eastman Kodak Co., Rochester, N. Y.
LASER MATERIAL STUDY Final Report, 1 Jul. 1962–30 Jun. 1964
Paul Mauer 22 Feb. 1965 25 p Submitted for Publication
(Contract Nonr-3834(00))
(AD-612459)

Three types of neodymium doped laser glass—a lanthanum-barium borate, a lithium–sodium silicate, and a barium crown—are compared because of their widely differing fluorescence characteristics. The glasses were fabricated into rods, 1.27 cm diameter and 30.5 cm long. Fluorescence decay data, optical quality data, output–input data, and output field patterns are included. The fluorescence characteristics were less significant than optical quality as a determinant in laser behavior. Author

N65-25904# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics
A CALCULATION OF THE THERMAL CONDUCTIVITY OF PURE SUPERCONDUCTING LEAD
Vinay Ambegaokar and James Woo Mar. 1965 38 p refs
(Contract Nonr-401(38))
(TR-2; AD-613658)

A semiempirical model for the density of phonon states and the electron–phonon coupling constants was used. The calculation is based on a strong-coupling theory, which has a quasi-particle limit that is valid for the calculation. The results are in fair agreement with experiment. A physical explanation for the anomalously large drop in the thermal conductivity of superconducting lead is suggested Author

N65-25953# Rutgers Univ., New Brunswick, N. J. Dept. of Physics
SPIN–LATTICE RELAXATION IN CESIUM–CHROME ALUM
Robert D. Turoff 1 Jan. 1965 12 p refs Submitted for Publication
(Contract Nonr-404(08))
(AD-612630)

The spin-lattice relaxation times of three lines of the E.P.R. spectrum at 9.6 kMc/sec of the Cr^{+++} ion in cesium chrome alum have been measured as a function of temperature between 1.6° K and 4.2° K and dilution between 0 and 36 (non-magnetic to magnetic ions) by the steady-state saturation method. The three lines were those at the lowest field (line 1), the second lowest field (line 2), and the highest field (line 3). The rates of relaxation increase with dilution for lines 1 and 2, and decrease with dilution for line 3. The dilution dependence for line 3 can be qualitatively explained by cross-relaxation, but the dilution dependences for lines 1 and 2 elude explanation. The relaxation rate of each resonance line shows at least two temperature dependences at each dilution. They are interpreted as arising from a combination of cross-relaxation and direct processes between 1.6° K and 3.0° K, and indirect processes between 3.0° K and 4.2° K. Author

N65-25974*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Materials Section
PHONON-DRAG THERMOPOWER IN Cu-Al AND Cu-Si ALLOYS
Irving Weinberg 1 May 1965 15 p refs
(Contract NAS7-100)
(NASA-CR-63333; JPL-TR-32-730) CFSTI: HC $1.00/MF $0.50 $0.50 CSCL 20H

The thermoelectric power of copper-aluminum (Cu-Al) and copper-silicon (Cu-Si) alloys has been determined from 4.2 to 320° K. Assuming that the thermopower is separable into diffusion and phonon-drag components, the change in phonon-drag thermopower ΔS_g is determined for Cu + 0.77 At.% Al and Cu + 1.12 At.% Si. The change in phonon-drag thermopower is analyzed using the method developed by Huebener for lattice vacancies in gold. Scattering of phonons by im-

purities is assumed to follow a Rayleigh scattering law with relaxation time $\tau_i = (a\omega^4)^{-1}$. From the change in phonon-drag thermopower it is found that $a = (0.9 \pm 0.4) \times 10^{-43}$ sec^3 for 0.77 At.% Al in Cu, and that $a = (6.5 \pm 2.3) \times 10^{-43}$ sec^3 for 1.12 At.% Si in Cu. These results are compared with the scattering parameter computed from the mass-difference term in Klemens' theory for scattering of low-frequency lattice waves by point imperfections. For Cu-Al, the results indicate that phonon scattering can be accounted for by the mass-difference term. The results for Cu-Si indicate that the mass-difference contribution to phonon scattering is of the same magnitude as the contribution from the combined effects of the elastic strain field and changes in the elastic constants of interatomic linkages. Author

N65-25980# Alfred Univ., N. Y.
SEMICONDUCTING MATERIALS. PART III: AN INVESTIGATION OF THE DIELECTRIC PROPERTIES OF SINGLE-CRYSTAL VERSUS POLYCRYSTALLINE MATERIALS Final Report
Donald L. Guile 12 Apr. 1965 118 p refs
(Contract Nonr-1503(01))
(AD-614472)

Studies were conducted to determine the effect of grain boundaries upon polycrystalline ceramic dielectrics. For this purpose, dielectric measurements of polycrystalline samples were compared with measurements on single crystals. An attempt was made to analyze the results using Koops approach which satisfies the case of a stratified dielectric. However, this approach is shown to be invalid for the samples studied as might be suspected since the assumptions by Koops are not necessarily satisfied. The dielectric properties of MgO single crystals and polycrystalline samples, MgF_2 polycrystalline samples and a ZnS sample are presented in graphic form. Activation energies are given for the loss mechanisms present. The effect of adsorbed moisture or gas on improperly prepared samples is demonstrated by comparing dielectric measurements with infrared transmission studies. It is concluded that the increased dielectric constant and dielectric loss in polycrystalline samples is due to a combination of conduction, probably ionic, and interfacial polarization with no unique relaxation time existing. Author

N65-25982# Westinghouse Electric Corp., Pittsburgh, Pa.
GROWTH AND CHARACTERIZATION OF SINGLE CRYSTALS OF RARE EARTH COMPOUNDS Quarterly Technical Report
[1965] 9 p refs
(Contract AF 49(638)-1245)
(QTR-7; AD-614435)

The spin disorder effect on scattering of the conduction electrons was examined together with the increases in the residual resistivity of Gd observed in various intrarare earth alloys. It was found that the extrapolated values of the spin-disorder resistivity ρ_{sd} reported in the literature were much too small to account for the inelastic scattering with spin flip. This large discrepancy between the calculated and extrapolated value of ρ_{sd} has heretofore been overlooked. It may imply the existence of short-range order of spins in the paramagnetic state at temperatures considerably higher than the Curie point. Resistance measurements were conducted on a polycrystalline sample of Si-doped $CrBr_3$. The electrical data revealed that the compound became a semiconductor only in the paramagnetic state. Below the Curie temperature it remained an insulator. The excess electrons donated by the Si atoms in $CrBr_3$ thus behave markedly differently from those donated by La in EuS. Experimental work was continued on the growth of crystals of La-doped EuS. An investigation was begun on Ba-doped NdS. Further progress was made in the study of the magnetic structures of the solid solutions of CrTe and CrSb. Author

N65-26008# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies
PROPERTIES OF CONDUCTION ELECTRONS IN IONIC CRYSTALS Final Report, 15 Jan. 1961–14 Jan. 1965
David Kahn [1965] 38 p refs
(Contract AF 49(638)-1017)
(AFOSR-65-0657; AD-614091)

Charge transport and charge interaction properties in alkali halide crystals were investigated, and the phenomena of photoconductivity, space charge formation, photodiffusion, ionic charge diffusion, and electron lattice interaction were studied. For most of the experiments described, the alkali halide crystals were additively colored by heating them in a closed container with a vapor of the metallic constituent. Photoconductivity measurements in the interior or an illuminated, additively colored potassium bromide crystal confirm the flatness of the interior potential. The effect on the photoconductivity of the recombination of electrons in the conduction band with negative ion vacancies to form F-centers was also investigated. Equations used for the linearized solution are given, together with diagrams of the circuit. Photodiffusion difference equations and ionic charge diffusion equations are being constructed and analyzed to determine the recombination and dissociation processes occurring in the crystal. An apparatus for measuring the coupling constant between the electron and the lattice is also being constructed. Tables, diagrams, and graphs summarizing the experimental data are included. LS.

N65-26062# Cambridge Univ. (England). Cavendish Lab.
A STUDY OF FERROELECTRIC MATERIALS Quarterly Technical Status Report, 1 Apr.–30 Jun. 1964
W. H. Taylor 28 Jul. 1964 7 p
(Contract DA-91-591-EUC-3055)
(QTSR-3; AD-461042)

Work is continuing on the determination of the room temperature structure of sodium niobate, $NaNbO_3$ and is now nearly completed. Measurement of cell dimensions at elevated temperatures showed transitions not previously reported. Preparations are being made for resumption of low-temperature work with a hydrogen cryostat. N.E.A.

N65-26064# Microwave Associates, Inc., Burlington, Mass.
RESEARCH ON MILLIMETER-WAVE GENERATION TECHNIQUES Quarterly Report, 1 Apr.–30 Jun. 1964
William J. Moroney, Myer Gilden, Joseph Pergola, and T. B. Ramachandran 31 Aug. 1964 31 p refs
(Contract AF 33(657)-10925)
(QR-5; AD-460952)

Quantum efficiency and spectral response measurements were further investigated using a gallium arsenide phosphide, gallium arsenide PIN photodiode. The maximum efficiency was 51% at 8550Å and was flat within 12% over an 800Å range. In the pulsing of bulk semiconductor materials for the generation of millimeter-waves, oscillations and instabilities of a large number of GaAs samples have been examined on a travelling-wave oscilloscope. These specimens have exhibited a variety of effects at threshold such as the spontaneous development of voltage spike, delay in starting of oscillations and current reduction. Furthermore, a broadband spectrum scanning arrangement under development is described. Author

N65-26071# Maryland Univ., College Park. Dept. of Physics and Astronomy
[INVESTIGATIONS IN THEORETICAL SOLID STATE PHYSICS] Final Report, 1 Sep. 1961–31 Aug. 1964
Richard A. Ferrell and Ralph D. Myers [1964] 13 p refs
(Grant AF-AFOSR-62-46)
(AFOSR-65-0656; AD-614136)

Several of the more interesting results obtained recently which may have a technological impact are briefly discussed. One of these has an important bearing on the possibility of the existence of room temperature superconductivity. It was shown that strictly linear superconductors cannot exist by examining the collective density fluctuations whose effects are deleterious to the superconducting ordering. Another recent result was to point out that the attenuation of transverse ultrasonic waves in superconductors can be used to probe the Pippard kernel in a more detailed fashion than has previously been possible, thus providing a quantitative check on this important aspect of superconductivity theory. A bibliography is included of papers written with support from this project on solid state physics. E.E.B.

N65-26090# Honeywell, Inc., Hopkins, Minn. Honeywell Research Center
MECHANICAL BEHAVIOR OF POLYCRYSTALLINE CERAMICS Final Report
W. B. Harrison Apr. 1965 16 p refs
(Contract DA-11-022-ORD-2441)
(AD-614265)

The fabrication of high density, high purity, fine grained polycrystalline MgO, NiO, and TiC ceramics from micron and sub-micron powders by sintering and hot pressing techniques is discussed. The influence of pore size, pore location, grain size, surface damage, grain boundary condition, and certain impurities on the room temperature fracture behavior of these cubic materials is summarized. Fracture behavior studies on chemically polished, polycrystalline MgO were made to 1200° C for various types of microstructures. Some ductility in certain high density MgO structures was observed at temperatures as low as 800° C and progressively more ductility occurred at the higher temperatures. Certain electrical behavior in NiO and TiC was studied and in the case of TiC, a preliminary correlation with mechanical behavior was made. Author

N65-26123# Texas Instruments, Inc., Dallas. Apparatus Div.
SOLID-STATE TECHNIQUES FOR MODULATION AND DEMODULATION OF OPTICAL WAVES Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Dayton D. Eden [1964] 61 p refs
(Contract DA-36-039-AMC-03250(E))
(U6-802400-6; AD-614712)

A continuing investigation on solid state techniques for optical wave modulation and demodulation is presented. Configurations for wide bandwidth light modulation using KTN were investigated. Of interest was a configuration using the low speed microwave excitation propagation in KTN. Apparatus is being readied for low temperature electro-optic measurements in KDP and deuterated KDP. Optical quality and temperature dependent dielectric susceptibility data were recorded. KDP use in traveling wave configurations is discussed and an experimental modulator is described. A 45° Z-cut KDP modulator was tested for optical quality and found to be nearly diffraction limited. Signal-to-noise ratio improvement from avalanche multiplication photodiodes at microwave frequencies was obtained from device structures exhibiting a uniform bulk avalanche, a high quantum efficiency, a short transit time, and low capacitance series resistance. A planar NPπP structure showed the most promise for microplasma free multiplication. It was concluded that a well made diode at avalanche will always be photon shot-noise limited rather than thermal noise limited even at very low light levels. Conditions relating to television picture quality as transmitted in the vhf region over a laser beam were discussed. Examples of obtained reception are shown. R.N.A.

N65-26125# Harry Diamond Labs., Washington, D. C.
COUPLING COEFFICIENTS AND THE THREE DIMENSIONAL, PIEZOELECTRIC CERAMIC CYLINDER
George K. Lucey, Jr. 15 Feb. 1965 31 p refs
(HDL-TR-1274; AD-614785)

Antiresonant freguency equations for piezoelectric, ceramic cylinders of any dimensions are defined and combined with previously derived resonant frequency equations to show the types of errors that could be encountered if frequency data from thick disks and short rods were used to calculate the coupling coefficients k_p and k_{33} using equations that are reported in the literature for samples having dimension ratios less than 0.1. It is shown that although Poisson's ratio alters the effect of the characteristic frequencies of such samples on coupling coefficient, the coupling coefficients will not necessarily be miscalculated. In addition, when calculated coefficients are erroneous, the values may be either high or low, depending upon the cylinder properties. This information supplements the IRE (IEEE) Standards which mentions high values only when such calculations are made. Author

N65-26131# Stanford Univ., Calif. Solid-State Electronics Lab.
BAND STRUCTURE AND SURFACE EFFECTS IN CADMIUM SULFIDE PHOTOEMISSION STUDIES
Neal B. Kindig Aug. 1964 181 p refs *Its* Tech. Rept.-5201-1
(Grant NSF GP-1033)
(SEL-64-095; AD-610738)

A study is presented on the effects of band structure and surface on cadmium sulfide photoemission. Photoemission measurements were made on single crystals of CdS which had been cleaved and tested in high vacuum at photon energies between 7.2 and 11.6 eV. The apparatus for cleaving and measuring photoemission is described. Important band structure features are deduced from the energy distribution and quantum yield measurements. The density of states is determined by assuming that direct conservation of crystal momentum is not an important selection rule. The results are used to study optical excitation processes and escape of electrons. The optical conductivity calculated from the density of states agrees with experimental values. The effects of surface conditions on photoemission from CdS were studied by comparing measurements made on samples cleaved in high vacuum with the corresponding results from surfaces prepared by other techniques. The energy distribution curve is shown to be a sensitive tool for studying surface conditions. The theoretical effect of band bending on energy distributions is considered. R.N.A.

N65-26236# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
THEORETICAL CORRELATION OF DISPLACEMENT EFFECTS FROM PROTONS, ELECTRONS AND NEUTRONS IN SILICON AND GERMANIUM
M. E. Wyatt 15 Mar. 1965 33 p refs
(Contract AF 33(615)-1715)
(GA-6229; AD-464728)

Patterns of the primary recoil atom spectra from electrons, protons, and reactor neutron collisions are presented. Experiments indicate that electrons produce displacements at a fairly constant rate, almost up to maximum energy recoil, which approximates the square of the incident of electron energy instead of producing a linear proportion as with protons. Scattering cross sections are intensified by nuclear elastic scattering as the incident energy is increased, primarily due to the growth of the first one or two peaks. Reactor neutrons contribute most damage at about the same energy as when the first

peak occurs. When total displacement cross sections are compared, the ratio of damage produced by 30 MeV protons to 30 MeV electrons was 27 for silicon and 20 for germanium; with 30 MeV and 50 MeV protons, the ratios were 1.5 and 1.4, respectively. There is some evidence that proton damage on solar cells may be related to nuclear star production. M.W.R.

N65-26244# General Electric Co., Schenectady, N. Y. Research Lab.
ELECTRICAL CONDUCTANCE IN ORGANIC SOLIDS Quarterly Technical Report, 1 Jan.–31 Mar. 1965
Charles M. Huggins and Oliver H. LeBlanc, Jr. [1965] 9 p refs
(Contract DA-31-124-ARO(D)-175; ARPA Order 462)
(AROD-4642-3; AD-463838)

This fifth quarterly progress report outlines the progress made on a two-year program to study the electrical characteristics of some organic solids. The work is divided along three general lines: a) the study of the transport of carriers injected into insulating (or poorly conducting) solids by an electron gun, b) a radical salt of tetracyanoquinodimethan, and c) the study of carrier transport in some amorphous systems. Modifications were made in the electron gun system which enabled us to resolve tranist times of less than 1 microsecond for bombardment-generated carriers. The EPR Spectra of two metallic TCNQ salts were observed between 80° and 300° K and found to obey the Pauli theory as expected. Some quantitative calculations were made for Cs_2TCNQ_3 based on a general model for the TCNQ salts. These substantiate the thesis that a Heitler-London model is appropriate for the semiconducting salts. The general direction and desired goals of this program are covered in the Technical Proposal submitted by the Principal Investigators on June 26, 1963. As of this date, no changes in program or intent are envisioned. It was proposed that certain research problems in three areas would be investigated: a. carrier transport in organic systems using electron injection, b. some physical measurements on tetracyanoquinodimethan ion radical salts, and c. determination of carrier mobilities and trapping in amorphous systems. Work has been pursued in each of three areas by the two principal investigators working individually and/or jointly. Author

N65-26300# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy
METALLURGICAL ASPECTS OF GaAs–Ge HETEROJUNCTIONS
R. S. Mroczkowski, M. C. Lavine, and H. C. Gatos Dec. 1964 31 p refs
(Contract Nonr-3963(05))
(TR-II; AD-609611)

The structure of GaAs-Ge heterojunctions prepared by a back melting process was studied by X-ray diffraction, metallographic and electron microanalyzer techniques. The boundary region between the GaAs and the Ge was found to consist of a four-layered band. A discontinuity between the two inner bands was brought about by solidification occurring simultaneously from the GaAs and the Ge side. The junction material on either side of the central discontinuity was found to have grown as a single crystal with the orientation of the parent substrate. It was found essential to determine the GaAs-Ge phase diagram. This was accomplished by a series of alloys containing 0 to 40 weight percent GaAs. Over this range the diagram is a simple eutectic with the eutectic point at 74 weight percent Ge and 845° C. The limiting solubility of GaAs in Ge was found to be less than 5 weight percent. The Kossel divergent beam X-ray technique was used to study orientation relationships across the boundary layer. Author

N65-26312# Texas Instruments, Inc., Dallas. Semiconductor Exploration Lab.
GALLIUM ARSENIDE–INDIUM ARSENIDE ALLOY SYSTEMS First Quarterly Progress Report, 1 May–31 Jul. 1964
R. W. Haisty, L. G. Bailey, and R. C. Sangster [1964] 16 p refs
(Contract AF 33(615)-1272)
(TI-08-64-120; AD-460933)

During this report period, we designed and constructed a reactor system for epitaxial deposition of (Ga,In)As alloys, performed a number of runs using both InAs and GaAs substrates, and made considerable progress in bracketing the reaction conditions required for deposition of the entire range of composition of (Ga,In)As. In addition, we have begun investigations on the effect of substrate orientation on deposit quality and quantity. At present, we are using high-purity, undoped source materials and semi-insulating GaAs substrates to obtain deposits suitable for evaluation of electrical and optical properties. Author Author

N65-26366# Office of Aerospace Research, Washington, D. C. Aerospace Research Labs.
CADMIUM SULFIDE: A HISTORY OF SEMICONDUCTOR RESEARCH AT THE AEROSPACE RESEARCH LABORATORIES
Nick A. Komons Sep. 1964 84 p refs
(OAR-64-11; AD-455519) GPO: $0.40

Research on cadmium sulfide and other semiconductor compounds, beginning in 1951 with a study of the growth of CdS and ZnS crystals, is documented. Efforts relating to growing CdS crystals and determining their properties are presented, and Group II-VI compound semiconductors are discussed. Among the chapters included are ones devoted to the photovoltaic effect, development of a CdS solar battery, and fluorescence and the tap effect. An energy model for CdS is also discussed. A selected annotated bibliography, which represents the laboratory's program in semiconductor physics, is included. M.W.R.

N65-26372# Texas Instruments, Inc., Dallas.
GALLIUM ARSENIDE MICROWAVE TRANSISTORS First Interim Engineering Report, 31 Jul.–31 Oct. 1964
Melvin Belasco, R. G. Moore, W. J. Beyen, and R. C. Sangster [1964] 33 p
(Contract AF 33(615)-2101)
(TI-08-64-155; AD-461530)

During this quarter, a new emitter material, composed of Au-Ge-S, was developed. This material gives a more uniform junction and better physical appearance than the Sn-Al(2%) emitter. There is an unwanted resistance associated with this emitter, however, and work is under way to eliminate it. The new emitter material appears to work satisfactorily to 300° C. The Zn diffusion process has been modified to reduce surface concentration. Transistors have been made using the S emitter with Mg-Mn diffusion and Mg diffusion. The Mg-diffused devices varied widely in quality, possibly because of some anomalous diffusion behavior of the Mg. Epitaxial p-layers were used to form transistor base layers. The best results seem to come from p-layers deposited on epitaxial n on n^+ substrates, rather than on n substrates. Epitaxial p on n on n^+ transistors with $h_{FE} = 30$ were made. Low doping levels in the base region have caused high r_b' in these devices. The epitaxial deposition process has been improved to eliminate undesirable layers and provide better layer quality. Optical studies on the emitted light from various types of transistors has led to a correlation between h_{FE} and deep impurity levels. These studies also indicated that Zn-diffused layers and p on n on n^+ epitaxial layers are free of these levels. Author

N65-26411*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF 40-MeV PROTONS ON SEMICONDUCTORS AS DETERMINED WITH AN IMPROVED METHOD OF MEASURING DIFFUSION LENGTH OF MINORITY CARRIERS
Marvin E. Beatty and Gerald F. Hill Washington, NASA, Jun. 1965 21 p refs
(NASA-TN-D-2817) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Radiation-induced changes in semiconductor materials from 40-MeV protons were observed during irradiation. These changes were determined by the application of an improved infrared method for obtaining the diffusion length of the minority carrier in the semiconductor material. The semiconductor materials investigated comprised the base region of p–n junction photovoltaic devices. The diffusion length and lifetime before, during, and after irradiation are presented in both graphic and tabular form as a function of integrated proton flux. The data obtained show that very short carrier lifetimes may be calculated by employing the infrared method. Author

N65-26426# Illinois Univ., Urbana. Electrical Engineering Research Lab.
STUDIES IN QUANTUM AND SOLID STATE ELECTRONICS Final Report
Paul D. Coleman et al 1 Feb. 1965 11 p refs
(Grant AF-AFOSR-272-63)

(1) Optical pumping in dark ruby: Attempts were made to get maser action in the submillimeter region by incoherent optical pumping in a solid. The absorption of thermal noise power in a microwave resonator by an appropriate crystal therein is regarded as capable of changing the fluorescent intensity in the crystal. The terminal level of the fluorescent line must be one of the levels between which there is microwave absorption. (2) Harmonic generation in HCN by multiple quantum conversion: a traveling wave interaction in a 2.5-meter section of RG 96/U waveguide containing HCN gas produced a peak power at 104.1 GC of 1.8 watts. (3) Submillimeter-wave spectroscopy: A submillimeter wave monochromator was designed and constructed that is capable of covering the spectral region from 100 microns out to about 2.5 mm in wavelength. (4) Mixing of laser light in a bulk photoconductor, beat notes of 3 GC were detected on production by Fabry-Perot mode frequencies of a laser when mixed in a bulk photoconductor and compared with previous results. TAB

N65-26472# Oak Ridge National Lab., Tenn. Chemistry Div.
ORTEP: A FORTRAN THERMAL-ELLIPSOID PLOT PROGRAM FOR CRYSTAL STRUCTURE ILLUSTRATIONS
Carroll K. Johnson Jun. 1965 133 p refs
(Contract W-7405-ENG-26)
(ORNL-3794)

This report describes a computer program for drawing crystal structure illustrations with a mechanical plotter. Ball-and-stick type illustrations of a quality suitable for publication are produced with either spheres or thermal-motion probability ellipsoids on the atomic sites. The program can produce stereoscopic pairs of illustrations which aid in the visualization of complex packing arrangements of atoms and thermal motion patterns. Interatomic distances, bond angles, and principal axes of thermal motion are also calculated to aid the structural study. The FORTRAN coding utilizes the comparable features of IBM 709/7090 FORTRAN II and CDC 1604/1604A FORTRAN 63 so that the program can be executed on a number of different machines which have 32 K word memories. The machine-oriented plotting subroutines are standard library-type routines with slight modifications. Both CalComp and Benson Lehner off-line magnetic-tape plotting systems have been used successfully. Sample stereo-figure illustrations and a viewer are included with the report. Author

N65-26476 Oak Ridge National Lab., Tenn.
EFFECTIVE MAGNETIC FIELD AND ISOMER SHIFT FOR Au–Ni ALLOYS AS A FUNCTION OF COMPOSITION
L. D. Roberts, F. E. Obenshain, J. O. Thomson (Univ. of Tenn.), W. K. Robinson (St. Lawrence Univ.), and W. B. Newbolt (Washington and Lee Univ.) *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 4–6 refs (See N65-26475 15-24) CFSTI: $6.00

Measurements of hyperfine structure for Ni-rich alloys and for pure Au metal were made at 4.2° K using a Pt^{197} source which decays through the 77.3 keV state of Au^{197}. The six-line hyperfine structure (hfs) spectra for alloys of 1, 3, 7, 10, and 20 at.% Au in Ni all consist of two unresolved triplets, each triplet barely resolved from the other. The data were fitted with theoretical absorption curves, taking absorber thickness into account and using the Hamiltonians for the ground and excited states. The hfs coupling determined by the curve fitting process was found to be proportional within experimental error of a few percent to 1-(c/0.60) , where c is the atomic fraction of Au. The hfs coupling is thus proportional to the average magnetic moment per atom of the alloy. Also, the observed isomer shift as a function of the atomic fraction of Au for the Au–Ni alloys follows a straight line passing through the observed isomer shift for pure Au of -1.26 ± 0.06 mm per sec. E.E.B.

N65-26501 Oak Ridge National Lab., Tenn.
RESPONSE OF GERMANIUM AND SILICON DETECTORS TO ENERGETIC BROMINE AND IODINE IONS
W. W. Walker (Ala. Univ.), C. D. Moak, and J. W. T. Dabbs *In its* Phys. Div. Ann. Progr. Rept., Period Ending Dec. 31, 1964 May 1965 p 125–127 refs (See N65-26475 15-24) CFSTI: $6.00

A number of germanium surface-barrier detectors were fabricated and exposed to energetic Br^{79} and I^{127} ions from a Van de Graaff accelerator, to spontaneous fission fragments from Cf^{252}, and to alpha particles from Am^{241} and Cf^{252}. Seven of ten detectors gave good resolutions of about 20 keV for alpha particles at 77° K. For purposes of comparison, several silicon detectors were also studied along with the germanium detectors. Pulse-height spectra for the two types of detectors are shown. The germanium detector was found to have poorer resolution. Curves of pulse height vs energy for bromine and iodine ions for the germanium detectors are also given. Analysis of the response curves for the six germanium detectors showed some variation in both pulse-height and in the slope. These experiments would seem to indicate that detector resolution and detector pulse-height are not necessarily related, since variations of resolution without variation of pulse-height defect were observed. E.E.B.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-25870# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research and Development Div.
PROPELLANT CONTAINMENT UTILIZING SCREEN MESH AND PERFORATED PLATE SURFACES
M. P. Hollister 29 Dec. 1964 17 p
(LMSC-A665481)

An experimental investigation of propellant containment, utilizing woven mesh or perforated plate surfaces, is described. A simple theory is presented, about which the experimental investigation and data presentation is centered. Author

N65-26368# Atlantic Research Corp., Alexandria, Va.
DYNAMIC MECHANICAL PROPERTIES OF SOLID PROPELLANTS Quarterly Technical Summary Report, 1 Jun.–31 Aug. 1964
C. N. Robinson Oct. 1964 33 p refs
(Contract NOw-64-0189-c; ARPA Order 22-61)
(QTSR-3; AD-461609)

The dynamic shear properties of selected solid propellants and the effects of certain variables on these properties are being investigated. Problems in the Fitzgerald apparatus temperature monitoring system were eliminated and earlier data corrected. Dynamic shear modulus measurements were made on a new batch of TPH-1001 polybutadiene acrylonitrile propellant. Comparisons of these data with results from an earlier batch show a significant difference between the mixes. Dynamic shear modulus data were obtained showing accelerated aging effects on the TPH-1001 propellant and moisture effects on the AEBA-10 polyurethane propellant. R.N.A.

N65-26442# Library of Congress, Washington, D. C. Aerospace Technology Div.
MOTOR, JET, AND ROCKET FUELS Review Article
17 May 1965 19 p refs
(ATD-P-65-31; AD-463912)

This report gives a comparison of the 1957 and the 1962 editions of a book on motor fuels. The editions are (A) Papok, K. K., and Ye. G. Semenido, eds. "Motor Fuels, Lubricants, and Fluids. v. 1. Motor Fuels". Third revised and enlarged edition. Moscow, Gostoptekhizdat, 1957. 512 p. and (B) Papok, K. K., and Ye. G. Semenido, eds. "Motor, Jet, and Rocket Fuels". Fourth revised and enlarged edition. Moscow, Gostoptekhizdat, 1962. 741 p. The purpose of this comparison is to show the nature of coverage of the enlarged 1962 edition. No further editions of the book are known at the present time. It is commented that the 1962 edition of the book is more descriptive, too general, and less readable than the 1957 edition. N.E.A.

N65-26554# Naval Radiological Defense Lab., San Francisco, Calif.
THE RADIOLYTIC DECOMPOSITION OF MONOMETHYLHYDRAZINE ROCKET FUEL
W. E. Shelberg 5 Apr. 1965 14 p refs
(USNRDL-TR-843)

The radiolytic decomposition of monomethylhydrazine (MMH) rocket fuel and the suppression of radiolytic gases generated from MMH by the addition of free-radical scavengers were investigated. Degassed specimens of MMH with and without free-radical scavengers were gamma irradiated with cobalt 60 and the resulting noncondensable gaseous products analyzed by gas chromatography. Two olefinic free-radical scavengers failed to suppress gas evolution thereby demonstrating that MMH does not decompose radiolytically via free-radical intermediates but rather through a molecular or ionic process. The addition of carbon tetrachloride as a gas-suppressing additive, increased gas evolution by initiating a chemical chain reaction. R.N.A.

N65-26558# Naval Ordnance Lab., White Oak, Md.
THE EFFECTS OF CONFIGURATION AND CONFINEMENT ON BOOSTER CHARACTERISTICS Final Report
I. Jaffe and A. R. Clairmont Jun. 1965 45 p refs
(NOLTR-65-33; AD-464450)

The purpose of this work was to examine the effect of certain changes in size, shape, and confinement on the effectiveness of tetryl boosters. Effectiveness was judged in two ways: by the booster's approximation to a plane-wave generator and by its initiating strength. Consequently the measurements made were of non-planarity (radius of curvature) of the detonation front emerging from the booster and of the shock velocity vs distance curves of the hydrodynamic disturbance it caused in Plexiglas. The changes made in confinement and shape of two-inch diam boosters caused no significant change in either performance property. Changes in booster length, however, had a marked effect. Booster effectiveness increases with increasing length and is still increasing at l/d of 4 contrary to literature statements that curvature of the detonation front is constant at $l/d \geq 3$ and that booster strength becomes constant at $l/d \geq 1.5$. The validity of using truncated cones in place of cylindrical boosters in large-scale field tests of detonability was confirmed. The variation of 50% gap thickness with booster length (and corresponding invariance of critical initiating pressure), for a given test material, was quantitatively measured. Author

N65-26615# Picatinny Arsenal, Dover, N. J. Propellants Lab.
LONG RANGE STUDY OF PREDICTION OF SAFE LIFE OF PROPELLANTS
Norris S. Garman, and James M. Murphy Apr. 1965 95 p refs
(PA-TM-1609; AD-464516)

A long range storage program on many of the standard modern propellant formulations is being conducted at Picatinny Arsenal. Propellant samples are conditioned at temperate, tropical, desert, and laboratory controlled accelerated conditions. Standard and experimental testing techniques are employed to determine the safe life potential of each study propellant, and in turn the test methods are being evaluated as to their applicability for establishing stability potential. It has been shown that stabilizer analysis is an effective means for determining the chemical stability of propellants, however, an analytical problem does exist with ethyl centralite. The 65.5° C. Surveillance Test and Propellant Quick Test both appear to be suitable surveillance tools, however, both have shortcomings. The Methyl Violet Heat Test has limited value for estimating stability potential of an aged propellant, and the Vacuum Stability and Taliani Tests to date have not proven to be particularly beneficial. The Viscosity Test results continue to show promise, and appear to correlate well with the other more reliable testing techniques. A better comprehension of propellant safe life concepts is being realized through the study of the test results of each propellant formulation under study. Author

N65-26631*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THERMAL STABILITY OF A COMMERCIAL PROPYL PENTABORANE (HEF-2) IN THE RANGE 147° TO 190°C
G. Mc Donald Washington, NACA, 13 Nov. 1957 8 p refs
(NACA-RM-E57H29) CFSTI: HC $1.00/MF $0.50 CSCL 21D
(Declassified)

The thermal stability of a commercial grade of propyl pentaborane (HEF-2) was investigated at temperatures of 147° and 190° C. The products of decomposition are hydrogen, hydrocarbons, and a solid nonvolatile yellow boron hydride. The

following equation was developed from which may be calculated the approximate time required to decompose 20 percent of propyl pentaborane at any other temperature:

$$\log(t_{20\%} - 2) = \frac{7.85 \times 10^3}{T} - 16.3$$

where T is temperature in °K and $t_{20\%}$ is the time in minutes required for decomposition of 20 percent of the sample.

Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-25859# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SECONDARY INJECTION THRUST VECTOR CONTROL
C. Z. Zimmerman, D. Starrett, and J. M. Vellinga [1964] 29 p refs
(AD-613689)

On the basis of experimentally acquired data, thrust vector control systems utilizing secondary injection of fluids into supersonic nozzles have been developed. Several widely divergent theoretical and analytical treatments of the phenomena have appeared as new applications were proposed. This paper reviews the several theories and attempts correlation with the experimental data. Author

N65-26085# United Technology Center, Sunnyvale, Calif.
FOURTH-STAGE SCOUT ROCKET MOTOR PROGRAM Fourteenth Semimonthly Progress Report, 1–15 Dec. 1964
23 Dec. 1964 7 p
(Contract AF 04(695)-588)
(UTC-2100-SMPR14)

The program schedule and significant accomplishments are identified. Four preliminary flight rating tests (PFRT) were conducted; one motor failed about 2.3 sec after ignition. Also, the case insulation redesign was completed. A 0.100-inch-thick section was added to the aft insulator and extended to the midpoint of the previously uninsulated area. The forward insulator will be extended aft to the same point with a 0.050-inch-thick section. Additional insulation material was also added over the polar fittings, and insulation was removed in the cylindrical section under the propellant slot. E.E.B.

N65-26308# Physics International Co., San Leandro, Calif.
EXPLOSIVE GAS GUN FOR RE-ENTRY SIMULATION Semiannual Report
18 Mar. 1965 30 p ref
(Contract DA-04-200-AMC-796(X))
(PI-PRS-024; AD-461431)

The objective of this research is the development of an explosive gas gun which will accelerate a 5- to 10-lb projectile to velocities of approximately 20,000 ft/sec (about 0.6 cm/μsec). To this end, a small, inexpensive, model gun, in a scalable geometry, has been used for acceleration experiments. The model gun requires about two pounds of explosive and accelerates projectiles of about four-grams mass. Two simple gun designs (with and without diaphragm), both permitting systematic variation of the experimental parameters, have evolved from the experiments to date. Techniques have been developed for using radiographic, photographic, and electronic instrumentation in conjunction with these experiments. Velocities of about 15,000 ft/sec (or 75% of the goal) have been reached by varying the experimental configuration only slightly; calculations indicate modifications that should enable the full velocity to be attained. Author

N65-26398# Aerojet-General Corp., Azusa, Calif. Aerophysics Dept.
EFFECT OF EXIT-CONE GAS-TRANSPORTATION ON ROCKET MOTOR PERFORMANCE
J. J. Williams 7 Feb. 1964 26 p refs
(TM-240-SRP)

Essentially, this report presents a method for determining the effect of gases injected through the walls of a rocket nozzle exit cone on the specific impulse. The technique, briefly, is divided into two steps; first, the boundary layer growth and wall shear for various injection rates are calculated using the momentum-integral approach; and second, the effect on thrust and specific impulse is calculated from the nozzle pressure distribution, wall shear and total mass flows with and without boundary layer injection. Author

N65-26399# United Technology Corp., Sunnyvale, Calif.
FOURTH-STAGE SCOUT ROCKET MOTOR PROGRAM Seventeenth Semimonthly Progress Report, 16–31 Jan. 1965
C. M. Frey 5 Feb. 1965 8 p
(Contract AF 04(695)-588)
(UTC-2100-SMPR-17)

Presented are the Program Schedule and the Major Milestone Schedule for the development of a solid-propellant rocket motor for the fourth stage of the Scout Vehicle. Motors S/N 20005, 20007, and 20008 were successfully static fired. Postfire condition of the first two motor cases and nozzles appeared excellent, the third motor revealed a 2 to 3 in. wide hot spot on the case adjacent to the forward edge of the aft case insulator. G.G.

N65-26468# National Gas Turbine Establishment, Pyestock (England).
THE DEVELOPMENT AND TESTING OF A COMBUSTION CHAMBER FOR 1400°C OUTLET TEMPERATURE AND A TEMPERATURE DISTRIBUTION BETTER THAN 3 PERCENT
P. Martin and E. L. Hartley Nov. 1955 27 p refs
(NGTE-M-248)

A combustion chamber for a high temperature turbine blade testing rig was developed to deliver 10 lb. per second per atmosphere up to 2 atmospheres at outlet temperatures up to 1400° C and with a temperature distribution better than 3 percent. The design considerations, development, and performance are described. Pilot zone performance tests were made at one and two atmospheres. The rich and weak extinction limits, the minimal initial outlet temperature on ignition, and the outlet temperature distribution were investigated. The high energy igniter fitted to the pilot zone gave good low temperature rise starting characteristics. Combustion efficiency remained high over a wide air to fuel ratio range. The pilot zone burned stably in air to fuel ratios of 700 to 1 to 30 to 1. Weak extinction occurred at 1000 to 1 but rich extinction could not

be measured because of high outlet temperature. Main combustion tests were made at a preheated constant air flow at up to two atmospheres. The pilot zone temperature rise greatly affected the overall efficiency at the weaker air to fuel ratios. This effect decreased with an increase in air to fuel ratio. No local hot spots developed on the hot unstressed wall. It was concluded that by feeding a homogeneous carburetted stream stage by stage into a flame tube having a hot pilot zone, the desired outlet temperature distributions with low losses can be obtained. R.N.A.

N65-26572# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

FEASIBILITY STUDY OF ADVANCED EXPLOSIVE CHARGE PROJECTORS Final Report, Jun. 1963–Feb. 1965

R. S. Pickford and J. E. Drever Eglin AFB, Fla., Res. and Technol. Div., May 1965 85 p refs

(Contract AF 08(635)-3653)

(ATL-TR-65-40; AD-464687)

A feasibility study was conducted on Government furnished shaped charge designs utilizing cylindrical or near cylindrical aluminum oxide liners. Theoretical analysis indicates that jet velocities can be achieved up to twice the velocity of sound in the liner material (10,500 m/sec). However, experimental data indicates that a jet was not formed during initial collapse of the liner, although jets were observed to be emitted after the detonation wave reached the end of the charge. These jets were composed of aluminum oxide particles less than .030 inches diameter and traveling at velocities believed to be in the 8,000 to 13,000 m/sec range. Additional tests, in which the charges were modified to increase the confinement impulse on the liner—larger explosive diameters and increased angle of approach between detonation wave and liner wall—also failed to produce a normally formed jet. However, a "normal" jet—again composed of small particles—was formed with a 34° conical aluminum oxide liner. Author

N65-26601*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A MIXING MODEL FOR ROCKET ENGINE COMBUSTION

Martin Hersch Washington, NASA, Jun. 1965 26 p refs

(NASA-TN-D-2881) CFSTI: HC $1.00/MF $0.50 CSCL 21B

A model for predicting rocket combustion performance is presented which is based on the assumption that performance is limited only by gas-phase turbulent diffusion, or mixing, of oxidant and fuel vapors. The model shows how mixture ratio, chamber length, injector-hole spacing, and turbulence intensity affect performance. The results of detailed calculations performed on an IBM 7090 computer for a number of propellant systems are presented. Author

N65-26616# AVCO-Everett Research Lab., Everett, Mass.

DETAILED PERFORMANCE EVALUATION OF THE MARK V SELF-EXCITED ROCKET DRIVEN MHD GENERATOR Final Technical Report

May 1965 89 p refs

(Contract AF 33(615)-1862; ARPA Order 291-62)

(AD-464257)

The power-weight characteristics of the rocket-driven, self-exciting modified Mark V magnetohydrodynamic generator were investigated with varying percentages of the generator output dissipated in the field coil and with various field coil coolants serving as propellant. Testing started with a mass flow of 73 lb/sec and a seed concentration of 2.0 mole% of K in the combustion gases at a temperature of 3000° K. At 87% of rated mass flow an excess of rated net output was observed. It was found that a proper relationship between battery preexcitation, burner ignition time, and rate of excitation is important to obtain self excitation, and that the proper voltage distribution in the segmented electrode power section insures a good net output of power. G.G.

N65-26630*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF AN ON–OFF, INLET SHOCK-POSITION CONTROL ON A 16-INCH RAM-JET ENGINE

Fred A. Wilcox, Eugene Perchonok, and Donald P. Hearth Washington, NACA, 29 Nov. 1954 40 p refs

(NACA-RM-E54I21) CFSTI: HC $2.00/MF $0.50 CSCL 21A

A shock-positioning control was investigated on a 16-inch ram-jet engine at Mach numbers from 1.5 to 2.16 and angles of attack to 10° in the 8- by 6-foot supersonic wind tunnel. The static-pressure rise across the inlet normal shock was utilized in setting the diffuser at its critical condition. A simple pressure-capsule sensing element was combined with an on–off fuel-flow actuating system; and successful operation was obtained during rapid changes of angle of attack, stream Mach number, and exit nozzle throat area. In addition, the control restored the engine to the desired condition from manually displaced operation in both the subcritical and supercritical inlet flow regions. Satisfactory prediction of the dynamic operation of the control was obtained by treating the system as having pure dead time. Author

N65-26647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ARC-JET THRUSTOR FOR SPACE PROPULSION

Lewis E. Wallner and Joseph Czika, Jr. Washington, NASA, Jun. 1965 72 p refs

(NASA-TN-D-2868) CFSTI: HC $3.00/MF $0.75 CSCL 21H

The arc-jet thrustor represents an engine for potential space applications requiring a specific impulse in the range from 1000 to 2000 seconds. As such it was originally thought that missions for the engine would fit somewhere between those suitable for the high thrust chemical and the very low thrust ion propulsion systems. The considerable effort expended to develop the arc thrustor has resulted in operation in the power range from 1 to 200 kilowatts, at specific impulse levels between 1000 and 2000 seconds, and for continuous running as long as 500 hours with overall efficiency up to 55 percent. Progress has been made on many of the early operating problems such as electrode-erosion, nozzle-cooling, and propellant-feed systems. In addition, theories have been advanced to explain, at least partially, the electric-arc operation. In substance then, the thermal arc-jet thrustor is now fairly well developed. Because of several factors unrelated to impulse and efficiency levels, however, the mission application of the arc thrustor is somewhat doubtful at the present time. These factors, for the larger arc-jet thrustor, include biological shielding, hardware availability, excessive electric generator weight, and reliability, for example. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-25627 Paris Univ. (France).
ULTRAVIOLET RADIATION FROM STARS
C. Pecker-Wimel *In* ESRO Rept. of the Colloq. on the Sci. Objectives of the Large Astron. Satellite Aug. 1964 p 18-31 refs (See N65-25625 15-30)

Rocket observations of ultraviolet radiation from stars during 1960 and 1961 are cited which are inconsistent with theoretical predictions; the current state of the art in estimation of stellar ultraviolet radiation is regarded as poor. For studying flux of stellar energy, comparison of observed flux with a model that specifies temperature and pressure variation with optical depth in the atmosphere of the star is recommended. When stars are too faint to be observed at 1 Å resolution, information on their energy distribution can be obtained using wide-band photometry. Observation of stellar ultraviolet can contribute greatly to study of the nature of the interstellar medium and of the shape of the extinction curve in ultraviolet. Interstellar lines in the observed spectra of stars can be used to derive information on space and velocity distribution of the interstellar gas and its chemical composition. J.M.D.

N65-25628 Sterrewacht Sonnenborgh, Utrecht (Netherlands).
ASPECTS OF X-RAYS AND GAMMA-RAYS
C. de Jager *In* ESRO Rept. of the Colloq. on the Sci. Objectives of the Large Astron. Satellite Aug. 1964 p 32-38 (See N65-25625 15-30)

Discovery of sources of X-rays and gamma rays in space is rapidly expanding. Nothing is known of the nature of the few sources already detected; in particular, degree of polarization, presence or absence of emission lines, and whether or not these sources are galactic, remain to be determined. Such sources are emitters of very energetic quanta, with energy levels of about 200 MeV, corresponding to wavelengths of about 10^{-4} Å. It was found analytically that galactic transparency is good for X-ray wavelengths shorter than about 8 Å. The possibility that the general background flux of 5 photons per square meter per steradian per second in the energy range above 200 MeV is due to X-rays or gamma rays from stars or galactic nebulae is discussed. It is recommended that flare stars which were recently discovered, and which are known to be radio emitters, be searched for X-ray radiation. J.M.D.

N65-25730# European Organization for Nuclear Research, Geneva (Switzerland).
SIMULATED COSMIC RAY IRRADIATION WITH 600 MeV PROTONS, VOLUME ONE. PART ONE: GENERAL REMARKS ON THE ASTROPHYSICAL, RADIOBIOLOGICAL AND EXPERIMENTAL ASPECTS
Antonio Pasinetti and Laura E. Pasinetti May 1965 78 p refs

Astrophysical, radiobiological, and experimental aspects of cosmic and space radiation are presented. The main physical characteristics and sources of cosmic, solar, proton beam, and inner and outer Van Allen belt radiation are discussed. The lethal dose, and relative biological effectiveness of high energy protons and pathology due to irradiation from these protons are examined. Irradiation experiments on white mice are described and include the hematological, histological, histochemical, electrophoretical, and biochemical tests performed, the physical and technical arrangements made for the proton beam radiation, and automatic irradiation and dosimetry apparatus used. R.N.A.

N65-26083*# Boeing Co., Seattle, Wash. Aero-Space Div.
SPACE RADIATION TESTS ON REFLECTING SURFACES Final Report
Jun. 1965 183 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950998)
(NASA-CR-63371; D2-36359-1) CFSTI: HC $5.00/MF $1.25 CSCL 20H

Tests were performed to determine the effects of charged particles on the thermal properties of solar concentrator coatings consisting of barrier-layer anodized aluminum reflecting surfaces, vapor deposited aluminum, chemically brightened aluminum, high-emittance barrier-layer anodic coatings, and spacecraft coatings of zinc oxide/potassium silicate, and zinc oxide/silicone. Specimens were bombarded with protons of energies 1 to 9 Kev and 2.5 Mev, and alpha particles of 2 to 16 Kev and 5.0 Mev. The barrier-layer anodized specimens exposed to particle flux ranges, simulating an Earth–Mars charged particle radiation environment, proved to be the most radiation resistant coatings tested, and required a flux of 9.25×10^{16} protons/sq.cm. to increase solar absorptance from 0.12 before irradiation to 0.23 after irradiation. Calculations found that current output reductions in a concentrating panel due to reflectance changes are negligible for an Earth–Mars mission. The zinc-oxide pigmented coatings were much more radiation sensitive than any of the other solar concentrator coatings. G.G.

N65-26113# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THEORETICAL INVESTIGATION OF GEOMAGNETICALLY TRAPPED ELECTRONS FROM HIGH-ALTITUDE NUCLEAR EXPLOSIONS Final Report
A. D. Anderson, G. E. Crane, W. E. Francis, L. L. Newkirk, and M. Walt Jun. 1964 161 p refs *Its* Rept.-3-26-64-1
(Contract DA-49-146-XZ-204)
(LMSC-895355; DASA-1480; AD-612737)

The report describes the results of a theoretical effort directed toward the identification of the loss mechanisms responsible for the eventual removal of electrons from the trapped population. The principal effort is directed toward the clarification of the role of the atmosphere in removing the electrons. TAB

N65-26324# RAND Corp., Santa Monica, Calif.
PROBLEMS OF MOTION OF LARGE METEORITIC BODIES IN THE ATMOSPHERE
V. A. Bronshten Apr. 1965 194 p refs Transl. into ENGLISH of the book "Problemy Duizheniia v Atmosfere Krupnykh Meteoritnykh Tel" Acad. of Sci., USSR, 1963
(Contract AF 49(638)-700)
(RM-4257-PR; AD-461790)

The basic elementary processes which take place in the very strong shock waves generated by the tremendous velocities of large meteorites, and their interaction with the meteoric body leading to melting and vaporization phenomena are discussed. Emphasis is placed on the kinetics of ionization and its influence on the temperature distribution in the shock wave. Calculations on the processes of ionization and recombination behind the shock front, on the radiation flux received by the body from the shock wave, and on the temperature distribution behind the front were performed. The relative role of these processes in the various portions of the flight and for different velocities is not completely clarified, but it was concluded that meteorites ablate both by means of fusion and vaporization. G.G.

N65-26360# Princeton Univ., N. J. Plasma Physics Lab.
ON THE EXPLOSION OF A SUPERNOVA INTO THE INTERSTELLAR MAGNETIC FIELD, PART II

R. M. Kulsrud, I. B. Bernstein, M. Kruskal, Jerome Fanucci, and Nathan Ness (RCA Labs.) May 1965 42 p refs
(Contract AT(30-1)-1238)
(MATT-307)

The problem of the earlier stages of the explosion of a supernova into the interstellar medium with a uniform magnetic field was discussed in Part I. In the present part the limit in which the magnetic field is weak is investigated. This limit corresponds to the Alfvén speed in the interstellar magnetic field being small compared to the expansion velocity of the supernova debris. The magnetohydrodynamic flow produced by the supernova is calculated to second order in the field strength. It is found that the expansion procedure breaks down near the supernova debris interface, where a boundary region occurs in which the magnetic field is large, no matter how small its interstellar value. The physical quantities at the debris are evaluated. It is suggested that this large field may be subject to a Rayleigh-Taylor instability and burst through the supernova debris interface, producing a filamentary structure with large magnetic fields such as is observed in the Crab Nebula. Other comparisons with the Crab Nebula are made.
Author

N65-26423*# California Univ., La Jolla. Physics Dept.
A SURVEY OF INNER ZONE PROTONS
R. W. Fillius and C. E. Mc Ilwain 13 Apr. 1965 50 p refs
(Contract NASr-116; Grant NsG-538)
(NASA-CR-63420) CFSTI: HC $2.00/MF $0.50 CSCL 20H

This report presents detailed data from a survey of trapped protons made by Relay I. Six energy channels from 1.1 to 83 MeV are analyzed to determine the stationary distribution of trapped protons as of January 1, 1963. This data is presented as the observed flux of locally mirroring particles plotted as a function of /B/ on each shell of force, and in the form of contour maps in B, L space. Although interpretation is reserved for a companion paper, it is believed that this data will be useful reference material for scientists investigating the trapped radiation.
Author

N65-26600*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MAGNETOSPHERE AND ITS BOUNDARY
Tatsuzo Obayashi Washington, NASA, Jun. 1965 11 p refs
(NASA-TN-D-2789) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Some highlights of the recent advent of magnetospheric studies are reviewed. The magnetospheric boundary, where the solar plasma interacts with the outer geomagnetic field, is discussed using various results of magnetic field and plasma measurements made by space probes. The observed spatial profile of ionized particle density and its implication to magnetospheric physics are also given.
Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-25625# European Space Research Organization, Paris (France).
REPORT OF THE COLLOQUIUM ON THE SCIENTIFIC OBJECTIVES OF THE LARGE ASTRONOMICAL SATELLITE Special Report No. 2
Aug. 1964 68 p refs Colloq. held in Paris, 24–25 Apr. 1964 1964

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N65-25626 Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
FUNDAMENTAL REQUIREMENTS OF MODERN ASTRONOMY
L. Biermann *In* ESRO Rept. of the Colloq. on the Sci. Objectives of the Large Astron. Satellite Aug. 1964 p 16–17 (See N65-25625 15-30)

Summary remarks on information published elsewhere on the subject of requirements in modern astronomy, and discussion of some spectrum measurements, are presented. The major point in the source document is repeated, which is that the discrepancy between theory and observation concerning the ultraviolet spectra of newly-formed stars can probably be resolved only by means of observations of the continuum and the spectral lines in the ultraviolet below 3000 Å.
J.M.D.

N65-25629 Royal Observatory, Edinburgh (Scotland).
INSTRUMENTAL QUESTIONS
H. E. Butler *In* ESRO Rept. of the Colloq. on the Sci. Objectives of the Large Astron. Satellite Aug. 1964 p 39–55 (See N65-25625 15-30)

Use of conventional instruments for astronomical satellite observations of spectra in the region 900 to 3500 Å is discussed. Difficulties in developing mirrors, scanning spectrographs, and photomultiplier detectors, are considered; concentration on spectrographs and detectors is recommended since improvements in efficiency by a factor of 100 are possible. The possibility of realizing 1 Å wavelength resolution over the whole spectral region for the secondary guidance system is discussed.
J.M.D.

N65-25698# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE NON-HOMOGENEITY OF THE MOON Mathematical Note No. 399
C. L. Goudas Mar. 1965 13 p refs
(DI-82-0421; AD-613645)

Fourier expansions of the lunar profile at libration angles different than zero were found for total eclipse measurements, and compared to the Fourier expansion of the limb

for full-moon measurements. It was concluded that the lunar limb as presented by photographic observations is very different from its form, based on the assumption that the moon is everywhere homogeneous. G.G.

N65-25740# RAND Corp., Santa Monica, Calif.
THE COMA CLUSTER OF GALAXIES. I: SIZE AND STRUCTURE
A. G. Wilson, Guy C. Omer, Jr., (Calif. Univ., Los Angeles) and Thornton L. Page (Wesleyan Univ.) Mar. 1965 27 p refs Submitted for Publication
(AD-613648)

Three independent counts of the Coma cluster of galaxies appear to be consistent with each other. This cluster contains some 800 members to photovisual magnitude about 18.5 and is about 100 minutes in radius. A possible spatial density distribution of the galaxies in this cluster is derived from the combined data. Author

N65-25748# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE EFFECTS OF RADIATIVE BRAKING ON FREE PERIODS OF STELLAR PULSATIONS
Zdenek Kopal Jan. 1965 26 p refs *Its* Mathematical Note No. 386
(D1-82-0403; AD-613587)

The virial theorem, generalized to include the effects of interaction of matter with radiation in stellar interiors, is used to evaluate the influence of such effects on the fundamental mode of free periods of radial oscillations. Two types of solution are considered: one of purely harmonic oscillations with phase-lag; the other oscillating in phase throughout the interior, but with complex frequency. In both cases, the interaction terms in the virial theorem introduce the luminosity (L) of the respective configuration in the equation for the period so as to make the latter increase with L. The quantitative effects of such influence are negligible for configurations of moderate density concentration, and could become appreciable only if this concentration became very high. The real art of complex frequency turns out to be positive and opens a possibility for the outward flux of radiation to feed energy into radial oscillations of the stars to give them a start if the central condensation of such a configuration is sufficiently high. Author

N65-25779# Illinois Univ., Urbana. Electrical Engineering Research Lab.
IONOSPHERIC RESEARCH Quarterly Progress Report, 1 Oct.–31 Dec. 1964
H. D. Webb [1964] 51 p refs
(Contract DA-36-039-AMC-03703(E))
(QPR-5; AD-612484)

Moon reflected signals have been received at 150.6 mc on 49 days for 373 hours and at 413.25 mc on 46 days for 85 hours. The observation times are graphed. Methods of resolving the n × 180° ambiguity have been studied. A thesis deals with large scale irregularities in electron content with traveling disturbances in the ionosphere as determined from ionograms. Author

N65-25795# RAND Corp., Santa Monica, Calif.
ANALYTIC TRAJECTORIES FOR AEROSPACEPLANE
F. S. Nyland Nov. 1964 83 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4357-PR; AD-612724)

The flight of a lifting vehicle to orbit speed is considered by studying four basic powered aerodynamic maneuvers: pull up, climb at a constant path angle, leveling off, and cruising at constant altitude. Solutions for trajectory parameters are presented for each phase of flight. Two basic forms of further research, of value to lifting-reentry technology, are suggested for application to aerospaceplane planning. Author

N65-25798# Advanced Research Projects Agency, Washington, D. C.
OBSERVATIONS OF THE NEAR WAKE REENTRY PHENOMENA BY THE MERCURY ASTRONAUTS
A. Goldburg, L. Hromas, C. E. Mc Lain, and J. Menkes, comp. [1964] 83 p refs
(ARPA-TN-64-2; AD-613015)

A study is presented on the near wake reentry phenomena observed by Mercury astronauts. Base flow and the near wake problem are reviewed. General characteristics, window properties, and outer surface materials of the Mercury spacecraft are described. Various special conditions pertaining to each of the four orbital Mercury flights and their effect on the near wake phenomena are discussed. Accounts of the astronauts observations during reentry are included. R.N.A.

N65-25827# RAND Corp., Santa Monica, Calif.
THE SCIENTIFIC STUDY OF METEORS IN THE 19TH CENTURY
Mary F. Romig Apr. 1965 21 p refs
(P-3108; AD-614411)

A survey of the astronomical literature of the 19th century was utilized to follow the development of meteor sciences, with emphasis on the progress of physical science in general during that time. The primary contribution of early investigators was the identification of chemical constituents and the study of the mineralogical structure of meteors. Scientific observations of shooting stars began in 1789 with determinations of height, direction, and velocity of 402 meteors, and eventually established their cosmic origin in opposition to earlier beliefs of atmospheric origin. G.G.

N65-25881*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON THE LUMINOUS EFFICIENCY OF METEORS
Franco Verniani Washington, Smithsonian Inst., 1965 35 p refs *Its* Contrib. to Astrophys., Vol. 8, No. 5
(Grant NsG-87-60)
(NASA-CR-63402) GPO: $0.30 CSCL 03B

The ratio of the photographic luminous efficiency to the square of the density for 400 Super-Schmidt meteors was computed from observational data, taking fragmentation into consideration. Luminous efficiency is independent of mass, brightness, atmospheric density, and fragmentation. Results obtained for small-camera meteors are in agreement with those obtained for super-Schmidt meteors but it appears that fireballs have a density twice that of fainter meteors. The mean relative density of meteors in the main recurrent showers was determined and each shower appears to have its peculiar density. R.N.A.

N65-25929# RAND Corp., Santa Monica, Calif.
A SELECTED BIBLIOGRAPHY OF RAND PUBLICATIONS ON SPACE RESEARCH, 1960–1964 (U)
H. S. Dordick and J. T. Sturak Apr. 1965 75 p refs
(RM-4508)

An annotated bibliography on space research is presented and includes economic and political implications of space, interplanetary flight, lunar flight, satellites, space applications, space operations, space science, and space technology. R.N.A.

N65-26020*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN SA-9/PEGASUS A POSTFLIGHT TRAJECTORY
Jonathan B. Haussler and Robert H. Benson 30 Apr. 1965 134 p refs
(NASA-TM-X-53251) CFSTI: HC $4.00/MF $1.00 CSCL 22C

This report presents the postflight trajectory for the Saturn SA-9/PEGASUS A test flight. Fourth of the Block II series, SA-9 was the first vehicle to carry a Pegasus payload. Trajectory dependent parameters are given in earth-fixed, space-fixed ephemeris, and geographic coordinate systems. A complete time history of the powered flight trajectory is presented at 1.0 sec intervals from first motion to S-I/S-IV separation and at 5.0 sec intervals from S-I/S-IV separation to insertion. Tables of insertion conditions and various orbital parameters are included in a discussion of the orbital portion of flight. Author

N65-26075*# RAND Corp., Santa Monica, Calif.
NOTE ON THERMAL PROPERTIES OF MARS
C. Leovy Apr. 1965 23 p refs
(Contract NASr-21(07))
(NASA-CR-63278; RM-4551-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 03B

As measured by Sinton and Strong, the variation of infrared emission from the surface of Mars with local time on Mars is here interpreted in terms of a simplified theory of diurnal temperature variations, in which the effect of the atmosphere is included. The results suggest a very low thermal conductivity for the upper few centimeters of the Martian ground. Such low conductivities appear to be possible only if the material composing these layers is very fine powder having a characteristic size of not more than a few microns. If a linear relationship is assumed between convective heat transfer and surface temperature, the appropriate constant of proportionality is on the order of 10^{-4} cal per cm^2 sec deg.
Author

N65-26151 Bellcomm, Inc., Washington, D. C. Flight Systems Div.
SPACE TRANSPORTATION
M. W. Hunter, II *In* Los Alamos Sci. Lab. Proc. of an Advanced Nucl. Propulsion Symp. 1 Jun. 1965 p 10-47 (See N65-26150 15-22) CFSTI: $7.00

The important parameters of interplanetary travel are discussed as an introduction to the subject of gaseous fission rocket propulsion. Specific impulse from nuclear reactions is given for various dilution ratios to show the differences between fission and fusion propulsion parameters. Also, a comparison is given of the relativistic and biological time dilation effects. In the region of 1/3 the speed of light, the rocket initial weight is about 100 times the final weight. A presentation of operating cost in dollars per pound of payload versus total velocity capability for single-stage vehicles with chemical, nuclear solid-core, and two different types of gaseous fission rocket engines is also given. Further, the containment and safety problems involved in nuclear fuel propulsion devices are discussed. E.E.B.

N65-26232# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
STUDIES OF THE CHARACTERISTICS OF PROBABLE LUNAR SURFACE MATERIALS Special Report No. 20
John W. Salisbury and Peter E. Glaser (Arthur D. Little, Inc.) Jan. 1964 320 p refs Prepared in cooperation with Arthur D. Little, Inc.
(Contract AF 19(628)-421)
(AFCRL-64-970; AD-613018)

This report presents the findings of a cooperative effort by scientists of the Lunar Planetary Research Branch of the Air Force Cambridge Research Laboratories and of Arthur D. Little, Inc., on theoretical and experimental studies to determine the nature and most probable physical form of materials on the lunar surface. The accomplish these goals, the following efforts were performed: (1) installation of an ultra-high-vacuum system to simulate the probable lunar environment, (2) selection of material samples to simulate the probable lunar surface, (3) experimentation on and analysis of these materials in a high vacuum, (4) studies of the behavior of clean surfaces in a high vacuum, (5) measurements of electrostatic phenomena in a high vacuum, (6) measurement of thermal properties in a high vacuum, and (7) spectroscopic studies. Author

N65-26255*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CONSIDERATIONS ON THE USE OF ATMOSPHERIC BRAKING FOR A TRANSFER INTO A MARTIAN ORBIT
Jacob H. Lichtenstein Washington, NASA, Jun. 1965 57 p refs
(NASA-TN-D-2837) CFSTI: HC $2.00/MF $0.50 CSCL 22C

An analytical investigation has been made into utilization of the Martian atmosphere for braking in order to transfer from an approach trajectory into an orbit about Mars. The investigation was restricted to that combination of entry angles and velocities that would permit the vehicle to skip out of the atmosphere in order to establish an orbit about the planet, and the vehicle which was used was a blunt-faced body typical of the Apollo spacecraft. The results show that for a ballistic vehicle the entry corridor is narrow, 3 nautical miles, but with some lift (angle of attack approximately 20°) the corridor widens to about 30 nautical miles. Aerodynamic braking can be utilized to reduce the approach velocity to orbital velocities without exceeding 10 Earth gravitational units and also can be used to change the orbit plane about 10°. In the approach-velocity range of interest, an ablative heat shield for aerodynamic braking was found to require considerably less weight than the rocket fuel for thrust braking.
Author

N65-26259*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF INTRINSIC DIFFERENTIATION TO ORBITAL PROBLEMS INVOLVING CURVILINEAR COORDINATE SYSTEMS
James C. Howard Washington, NASA, Jun. 1965 28 p refs
(NASA-TN-D-2861) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Absolute or intrinsic differentiation has been shown to be an effective tool for solving a certain class of vector problems. In many cases, the solution of problems involving the rates of change of vectors may be obtained more directly by this method than by conventional methods. A single formula with sufficient generality to handle a wide range of problems renders application a purely mechanical process, requiring little or no ingenuity on the part of the analyst. In order to demonstrate its utility, the method has been used to process certain fundamental vectors associated with the orbits of planetary bodies or space vehicles. The processing of these vectors leads to Lagrange's planetary equations. It is shown that the method has distinct advantages when used for obtaining the rate of change of the argument of perifocus of an orbiting body. Author

N65-26413*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT ON METEOR FLIGHT OF COOLING BY RADIATION AND ABLATION

H. Julian Allen, Barrett S. Baldwin, Jr., and Nataline A. James Washington, NASA, Jun. 1965 63 p refs
(NASA-TN-D-2872) CFSTI: HC $3.00/MF $0.75 CSCL 03B

The parameters of meteor flight are evaluated taking account of surface radiation as well as vapor ablation. Results are presented for four meteoroid materials: tektite, stone, pumice, and iron. The calculations are based on a spherical shape with a range in radii of 10^{-8} to 5×10^{-3} meters. Entry velocities from 11 to 70 kilometers per second are considered. Because of an approximate similarity a large range of entry angles is covered. The validity of this approximation and of a number of assumptions is investigated. A significant result of the investigation is the rediscovery of surface radiation as a possible explanation, instead of fragmentation, for the anomalous behavior of the light curves of faint meteors. Author

N65-26441# Library of Congress, Washington, D. C. Aerospace Technology Div.
METEOR PHYSICS AND EXTRATERRESTRIAL MATTER Comprehensive Report
21 May 1965 58 p refs
(ATD-P-65-25; AD-464164)

Discussed are a number of physical phenomena associated with the flight of meteors in the terrestrial atmosphere and their origin in interstellar space. The following topics were studied: *Meteoric Matter in Interplanetary Space*—mean number of meteors with a restricted mass recorded by radar, wind velocity in the meteor zone by radar measurements, change of meteoric particle orbit within the resistant atmosphere, and recording of meteoric particles by the Mars-1 Interplanetary Station; *Ionization of Meteoric Trails*—the probability of meteoric ionization, the scattering of a plasma path under turbulent diffusion, and other studies; *Physical Properties of Moving Meteors*—motion of artificial satellites in the plasmas of the ionosphere, of interplanetary space, and of cosmic or interstellar space, fragmentation of meteoric bodies, and other studies; *Investigations of the Tunguska Meteorite*—retrograde motion of the meteorite, anomalous light and mechanical phenomena associated with the meteorite, and other observations; included is also a short review of several books pertaining to meteors, that were published in the Soviet Union during 1956 through 1962. G.G.

N65-26584# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF FEBRUARY 1965
[1965] 12 p

An ephemeris of satellite optical observations is given, and the reporting stations are listed together with their observations. L.S.

N65-26602*# National Aeronautics and Space Administration, Washington, D. C.
[COMMENTS ON THE PROBLEMS, SOLUTIONS AND OPPORTUNITIES OF NASA IN MEETING THE CHALLENGE OF SPACE ACCOMPLISHMENTS] News Release
James E. Webb 23 Jun. 1965 17 p Presented at the Defense Suppy Agency, Alexandria, Va. Available from the Scientific and Technical Information Division CSCL 22A

Mr. James E. Webb, administrator, National Aeronautics and Space Administration discusses the scientific and technological potentialities involved in the exploration of space. The wide-spread participation of American industry in research and development of space technology led to accomplishments in a variety of programs to improve existing aircraft types, to develop new aircraft concepts and satellite systems. Significant expenditures of skilled manpower, natural resources, and money must be made as space exploration is continued beyond the moon. G.G.

N65-26623# Library of Congress, Washington, D. C. Aerospace Technology Div.
DATA ON SOVIET SPACE PROGRAM, ANALYTICAL SURVEY Surveys of Soviet-Bloc Scientific and Technical Literature
8 Jun. 1965 21 p refs
(ATD-P-65-37; AD-464647)

This report contains a selection of Soviet technical papers and attempts to give a view of some space exploration problems as they existed at the end of 1964. The problems which are treated are divided into four sections: (1) supersonic and hypersonic aircraft; (2) Soviet research in space biology; (3) Soviet exploration of the moon; and (4) the Voskhod Spacecraft. N.E.A.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-25630 European Space Technology Center, Delft (Netherlands).
POSSIBLE DESIGNS FOR A LARGE ASTRONOMICAL SATELLITE
A. W. Lines *In* ESRO Rept. of the Colloq. on the Sci. Objectives of the Large Astron. Satellite Aug. 1964 p 56–62 (See N65-25625 15-30)

The specifications for the astronomical satellite design are reviewed, with respect to resolution which affects the control system, the number of telescopes, size of telescope mirror, and accuracy of detection. The reference systems in four proposed satellite designs are discussed briefly. It is suggested that instead of having a single precise specification of 1 Å, a whole bracket of resolutions be chosen with an indication of type and importance of scientific experiments which could be done at each level in the bracket. J.M.D.

N65-25644*# National Aeronautics and Space Administration, Washington, D. C.
PROJECT RANGER
[1964] 1 p
(NASA Facts, Vol. 11, no. 6) GPO: $0.20 CSCL 22A

A summary of the Ranger project is presented and includes new knowledge of the lunar surface gained from Ranger photographs; facts about the moon; a description of the television system, telemetry, command system, power supply, and in-flight correction rockets; the spacecraft dimensions, launch considerations, and a description of the flight plan. R.N.A.

N65-25766# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research
NRL SOLAR RADIATION MONITORING SATELLITE: DESCRIPTION OF INSTRUMENTATION AND PRELIMINARY RESULTS
Robert W. Kreplin [1964] 37 p refs Presented at the Comm. on Space Res. (COSPAR) Symp., Florence, 11 May 1964
(AD-461011)

Instrumentation of an orbiting satellite which measured solar X-ray flux is described, and an analysis of four months of continuous data readings is presented. Five photometers were used, which were gas filled ionization chambers sensitive in different but overlapping regions of the soft X-ray spectrum. Fluxes were measured in the bands 0 to 8, 8 to 20, and 44 to 60 angstroms. The solar radiation satellite was placed in orbit with its spin axis roughly perpendicular to the sun–satellite direction with an initial spin rate of about 2 rps. The minimum flux value measurement was 1.8×10^{-2} ergs cm^{-2} sec^{-1}. Some measurements indicate the existence of an active plage region. Observations in the Van Allen belt show significant time variations in particle flux. J.M.D.

N65-26017# Aerospace Corp., El Segundo, Calif. Cost Analysis Dept.
GHOST AND SCOMO SYSTEMS COST ANALYSIS
R. M. Carlisle 14 Apr. 1965 41 p refs
(Contract CWB-10857)
(ATR-65(7060)-5)

Ten-year operating costs for Global Horizontal Sounding Technique (GHOST) and Satellite Collection of Meteorological Observations (SCOMO) systems were derived. The SCOMO costs presuppose that GHOST will accommodate it by the addition of a 25-pound communications unit. For both systems, an average of two years between satellite replacement has a significant effect on total costs. For GHOST, over half of the total operating cost is due to the large number of balloons in the system and their relatively frequent replacement rate of every six months. The satellite configuration used for cost determination of both systems consists of three equally spaced equatorial satellites in synchronous orbits and one satellite in low-altitude polar orbit. Costs of other configurations can be derived from these data. The GHOST system costs are expressed as a function of replacement rate of the satellite for selected balloon unit costs as well as balloon replacements; those for SCOMO as a function of time between satellite replacement. Balloon power supply data and operating costs for Omega ground stations are given. M.W.R.

N65-26033# Joint Publications Research Service, Washington, D. C.
GUIDED MISSILE RESEARCH AND DEVELOPMENT IN THE JAPANESE DEFENSE AGENCY
8 Jun. 1965 19 p Transl. into ENGLISH of the publ. "Koku Uchu Nenkan" Tokyo, Japan Aeron. Assoc., 30 Jul. 1964 p 126–131
(JPRS-30475; TT-65-31190) CFSTI: $1.00

Guided missile research, development, and technology for Japan's defense program are presented. Included are a discussion of its past and future development; experimental surface-to-air, air-to-air, and antitank missiles; technical research on high precision remote metering devices and solid and liquid propellants; and a description of test sites and missile flight tests. R.N.A.

N65-26309# White Sands Missile Range, N. Mex. Inter-Range Missile Flight Safety Group
A GUIDE FOR RANGE SAFETY DATA REQUIREMENTS FOR UNGUIDED PROBE VEHICLES
Sep. 1964 16 p refs
(IRMFSG-305-64; AD-461410)

This paper presents a method of resolving the Range Safety problems associated with unguided probe vehicles. The detailed requirements placed upon a Range User, the data and format required, the method of handling the required data, the dispersion analysis procedure, and the computer and graphical methods of impact prediction are discussed. Author

N65-26356# Rocket Power, Inc., Mesa, Ariz.
RAVEN METEOROLOGICAL SOUNDING VEHICLE
Vaughn D. Williams Jun. 1965 13 p
(DOC.-7691A)

The configuration of the RAVEN single stage meteorological sounding vehicle is described and an outline of its modification work to improve thrust performance and reduce aerodynamic drag is given. The vehicle exhibited an altitude capability of 200,000 feet and above, and a summary of the completed 25 flight data is presented in a table. The common payload for the RAVEN is a telemetry transmitter and a parachute for the instrument package that is operated by a pyrotechnic delay. Reliability of the expulsion system has been more than 95%. G.G.

N65-26358*# National Aeronautics and Space Administration, Washington, D. C.
NASA TO LAUNCH 10TH TIROS SATELLITE FOR WEATHER BUREAU
25 Jun. 1965 16 p
(NASA News Release-65-197) Available from the Scientific and Technical Information Division CSCL 22B

The latest TIROS weather satellite, to be designated TIROS X, is described. Information on its flight plan, the spacecraft and its vidicon television system, polar sun-synchronous orbit, stabilization and control subsystems, and the Delta launch vehicle are included. R.N.A.

N65-26420*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NUMBER 9
15 May 1965 19 p
(NASA-TM-X-56567; X-533-63-1) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Data, compiled as of May 15, 1965, are presented on several satellites and satellite objects which were launched from the United States, Russia, England, Italy, and Canada, during the period 1958 to 1965. The data presented include the object code name, catalog number, launch date, period minutes, inclination, apogee, perigee, and transmitting frequency, computations. N.E.A.

N65-26421*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NUMBER 8
30 Apr. 1965 18 p
(NASA-TM-X-56568; X-533-63-1) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Data, compiled as of April 30, 1965, are presented on several satellites and satellite objects which were launched from the United States, Russia, England, Italy, and Canada, during the period 1958 to 1965. The data presented include the object code name, catalogue number, launch data, period minutes, inclination, apogee, perigee, and transmitting frequency computations. N.E.A.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-25570 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

SKIN DUCTING SYSTEM CONFIGURATIONS FOR LFC AIRCRAFT MAIN STRUCTURAL BOX

Robert N. Worth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 801-808 (See N65-25560 15-01)

A wing skin system configuration for a boundary layer control (BLC) aircraft is described. It is a double skin design with extensive use of honeycomb sandwich material, and can provide efficient support for binding and torsional loads, and an efficient ducting system which allows the passage of suction air from the wing surface to the compressor system. This configuration consists of a basic structural outer skin supported on multiple stringers, and an inner skin below the stringers which imparts stability to the stringer flanges and also provides a lower wall to complete the ducting passage. J.M.D.

N65-25571 Northrop Corp., Hawthorne, Calif. Boundary Layer Research Section

EFFECT OF WEATHERING ON TYPICAL BONDED BOUNDARY LAYER CONTROL STRUCTURE

R. N. Worth *In its* Sum. of Laminar Boundary Layer Control Res., Vol. II Mar. 1964 p 809-821 (See N65-25560 15-01)

The weathering tests on boundary layer control panels conducted during this program indicated that suction flow rates can be held to within 2.5 percent of the design values with present methods for washing and steam cleaning of aircraft. Results from salt spray exposure tests indicated the desirability of providing protection for the slots and holes by either an anodizing or an Iriditing process. Ground operation or storage of BLC aircraft without special protection seems feasible. Results of the ninety-day industrial exposure and the sixty-day tropical exposure tests indicate that vacuum cleaning from the slot side only can restore the flow rate to within 5 percent of the original value while steam cleaning at 100 psi from the slot side only can restore the flow rate to within 1.5 percent of the original values. The results of the metal to metal strength tests to determine adhesive strength characteristics showed no deterioration of the bond during the weathering exposures. The results of the honeycomb peel and tensile tests indicated that the adhesive was attacked somewhat by humidity weathering conditions. However, all strength values were adequate for future LFC work. Author

N65-25635# Lockheed Missiles and Space Co., Sunnyvale, Calif.

MINIMUM-WEIGHT ANALYSES FOR HONEYCOMB SANDWICH PLATES AND SHELLS

A. Bruce Burns Jul. 1964 59 p refs
(Contract NOw-63-0050)
(LMSC-2-60-64-31; AD-613323)

Minimum-weight analyses and resultant design data are presented for flat plates subjected to edgewise compression, in-plane shear, or normal pressure, for circular cylinders subjected to uniform, external hydrostatic pressure, and for circular cones subjected to uniform, external hydrostatic pressure. Comparisons are made with the results of previous minimum-weight analyses for other constructions. In all comparisons, the potential minimum structural weight of honeycomb-sandwich construction is shown to be considerably less than the minimum structural weight of other constructions under elastic stress conditions. In minimum-weight honeycomb-sandwich construction, elastic stress conditions are shown to be present only at very low loading indexes for most structural materials. Thus, for the majority of practical designs, minimum-weight honeycomb-sandwich facings are stressed to the maximum permissible stress. At high loading indexes where both minimum-weight conventional and honeycomb-sandwich constructions are stressed to the maximum permissible stress, conventional construction is more efficient due to the ineffectiveness of the honeycomb core in supporting the applied load directly. Author

N65-25643# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

THE VIBRATION OF A TIGHT CABLE CONTAINING A TURNBUCKLE Mathematical Note No. 397

F. Edward Ehlers Mar. 1965 26 p
(DI-82-0418; AD-613673)

The partial differential equations for the vibration of a cable containing a turnbuckle are solved by the method of the Laplace transformation and also by separation of variables. Since the turnbuckle renders the boundary conditions inhomogeneous, the eigenfunctions are not orthogonal in the classical sense, and a special scalar product is defined to make them orthogonal. The solution by separation of variables is simpler in form than the Laplace transform result for this particular problem, and is shown by the use of identities in the eigenfunctions to yield the identical expansions as the Laplace transform method. The results simplify considerably when the turnbuckle is located in the center of the cable or at one end. The properties of these special cases are discussed. Author

N65-25679# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

AN AIRCRAFT FATIGUE MONITORING SYSTEM Final Engineering Report

Reginald E. Hooson 1 Feb. 1965 144 p refs
(Contract NOw-61-0853-c)
(AD-612727)

The development of a fatigue damage indicating system, using metal monitors bonded to the airplane structure, is presented. Development included a series of laboratory tests to determine suitable monitor designs, and to evaluate various adhesive systems. Monitor installations on the full scale fatigue tests of both the Grumman A6-A (Intruder) and E2-A (Hawkeye) airplanes are also evaluated. Further development work is recommended. Author

N65-25758# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
PHOTOELASTIC DETERMINATION OF ELASTIC AND PLASTIC DEFORMATIONS AND OF CRYSTAL FRAGMENTATIONS IN METALS
Z. Zandman 9 Oct. 1964 21 p Transl. into ENGLISH from Rev. Met. (Paris), v. 53, no. 8, 1956 p 638–644 Presented at the Fall Meeting of French Met. Soc., Paris, 28 Oct. 1954
(RSIC-306; AD-613694)

A photoelastic method is described for measuring local elastic and plastic deformations created on metallic surfaces subjected to loads. The method is based on the incidental birefringence acquired by plastic materials subjected to stresses. To measure the surface deformations, the specimen is coated with a strongly photoelastic plastic material which exactly follows the metal deformations. By measuring the coating birefringence, the deformation can be calculated in the elastic and plastic range. The photoelastic coating acts as an infinite number of extensometers distributed uniformly on all points of the surface. This method makes it possible to pinpoint the initiation of the plasticizing process, the geometric shape effect on the specimen, the crystal fragmentation made according to the metal used, and the weak areas of welded, forged, and riveted pieces. R.N.A.

N65-25772# David Taylor Model Basin, Washington, D. C.
AXISYMMETRIC ELASTIC STRESSES IN CIRCULAR CYLINDRICAL SHELLS STIFFENED BY INTERNAL CHANNEL SECTIONS AND SUBJECTED TO UNIFORM EXTERNAL PRESSURE LOADING
Kenneth Hom May 1964 29 p refs
(DTMB-1811; AD-602076)

A theoretical analysis of the axisymmetric elastic deformations and stresses in a circular cylindrical shell internally stiffened by inverted channel frames under uniform external pressure loading is presented. The solution is based on the use of edge coefficients for plate and shell elements to determine the edge forces and moments arising at the common juncture of these elements. Equations are given for computing numerically the stresses in the elements of the composite structure once the edge forces and moments are determined. Author

N65-25817# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
STUDY OF RESIDUAL STRESSES IN THICK GLASS FILAMENT REINFORCED LAMINATES Quarterly Progress Report No. 3, 30 Dec. 1964–30 Mar. 1965
F. E. Stone 30 Mar. 1965 64 p refs
(Contract NObs-90301)
(SM-47833; AD-612951)

Analyses of residual radial and circumferential stresses are reported for 14 dispersed construction cylinders and 32 all-hoop scaling rings. Test and theory are compared relative to bending stiffness of the cylinders and to provide insight as to the relative importance of the fabrication effects which influence the final residual stresses. Author

N65-25833# Radio Corp. of America, Burlington, Mass. Aerospace Communications and Controls Div.
MECHANICAL HYDROFOIL CONTROL SYSTEM PRELIMINARY DESIGN STUDY PROGRAM Final Report
R. C. Blanchard, J. Dubbury, J. Hatfield, and D. Wellinger Jul. 1963 387 p refs
(Contract NObs-86448)
(CR-588-93; AD-419085)

Methods of improving the open-loop behavior of hydrofoil craft are investigated, and applications of the methods to Fresh, a 15-ton high-speed test craft, are evaluated with respect to stabilization and both manual and automatic control under State 3 Sea conditions. Three foil suspension schemes were studied to determine their abilities to counteract the influences of wave particle orbital motion disturbances on the foil and to minimize the resulting forces on the hull. To provide a means for applying controlling forces on the hull and foils of the craft in the presence of spring-mounted foils, three mechanical and hydromechanical mechanisms were evolved. Extensive analysis indicates that manual control is unsatisfactory since it entails a high probability of loss of control even during short runs in a State 3 Sea environment. J.M.D.

N65-25847# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
SANDWICH SHELLS WITH FACES OF DIFFERENT THICKNESS AND ELASTIC MODULI SUBJECTED TO EDGE LOADS AND THERMAL STRESSES
G. Stoffmacher Oct. 1963 48 p refs
(SM-45770)

The state of stress and deformation, for a thin rigid-core sandwich shell with different thickness facing and different moduli of elasticity subjected to edge loading and thermal stresses, is defined. Under certain specified conditions and when equivalent quantities are introduced, correlation is shown to exist between monocoque and sandwich shells. The stress–strain relations and equilibrium equations are presented for the thin sandwich shell without restrictions to rigid core construction or conical shape. Author

N65-25853# Stanford Research Inst., Menlo Park, Calif.
EVALUATION OF THERMAL STRESS RESISTANCE IN POTENTIAL RADOME MATERIALS Final Report
David A. Brown 15 Feb. 1965 46 p refs
(Contract Nonr-4213(00)(X))
(AD-613009)

The relative thermal stress resistance of five potential radome materials was experimentally determined for heating conditions which simulated radome environments. The effects of wall thickness and notches were also studied. Pyroceram 9608 was found to be the most thermal stress resistant of the five materials studied; the others, in decreasing order of merit, were Pyrex 7740, AD-99 alumina, MgO (99+% dense), Alundum RA-3360. The effects of notches and of the wall thicknesses studied (1/4 inch and 3/8 inch) were small compared with the differences between materials. However, theoretical considerations, together with extrapolation of experimental results, indicated that considerable improvement in thermal stress resistance might be obtained from much smaller wall thicknesses (0.10 inch or less). A fair correlation was obtained between the experimental results and four pertinent parameters. Pyroceram 9608 ranked as the most thermal stress resistant material in the ratings obtained from all four parameters. Author

N65-25867# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group
ENVIRONMENTAL CONDITIONS TO BE CONSIDERED IN THE STRUCTURAL DESIGN OF AIRCRAFT REQUIRED TO OPERATE AT LOW LEVELS Technical Report, Jun.–Dec. 1964
William H. Austin, Jr. Jan. 1965 22 p refs
(SEG-TR-65-4; AD-614460)

The power spectral density approach is considered the most reasonable definition of the turbulence-environment at low level. Because a critical need for low-level design criteria exists, low-level power spectral exceedance curves have been

derived from a B-66 low-level gust study, an F-106 low-level high-intensity gust program, and B-52 fleet service experience. These data indicate that low-level lateral turbulence is from 15% to 30% more severe than vertical turbulence. Much additional effort is required in the area of low-level turbulence before structural engineers can have complete confidence in their low-level turbulence design criteria. Author

N65-25891# General Technology Corp., Torrance, Calif.
FINITE DIFFERENCE APPROXIMATION OF THE DEFLECTION EQUATIONS OF A CONICAL SHELL WITH CLOSED BASE
J. Heller Sep. 1964 35 p refs
(Contract DA-11-022-ORD-2917)
(TR-1-22; AD-612664)

In this report we give finite difference approximations to the differential equations for the following problems: (1) the bending of a variable-thickness truncated right conical shell attached to an axially and sectionally symmetric base plate of variable thickness, (2) the bending of two joined variable-thickness truncated right conical shells. In case (1) above, the terms arising from consideration of the transverse deflection of the base caused by radial loading have been included. As a consequence the finite difference equations are non-linear. For solutions of these equations we suggest an iterative scheme combined with a direct method based on the factorization theorem for square matrices. In case (2), the finite difference equations are linear and procedures for solution are straightforward. Author

N65-25894# Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research
EXPERIMENTAL STRESS ANALYSIS OF A ONE-SIXTH SCALE MODEL OF AN ANECHOIC PRESSURE VESSEL Final Report
W. R. Schmidt and A. G. Pickett 8 May 1964 43 p
(Contract Nonr-3704(00))
(AD-612872)

An experimental stress analysis was conducted to confirm the design feasibility of a double wall 40-foot diameter spherical pressure vessel to be used as an anechoic chamber. Electrical resistance strain gages were used to measure strains on the surface of the test article, a one-sixth scale model of the anechoic vessel, for several combinations of internal pressure, annulus pressure, and dead weight loads. The experimental analysis confirmed that the conceptual vessel is a feasible design for a full scale anechoic tank with a pressure rating from 4000 to 5000 psig. The vessel support design, access opening reinforcement design, inner shell support scheme, and closure design appear adequate. The location of the most highly stressed area in the vessel at the fillets of the access opening reinforcing ring to shell junctions is such that reduction in stress concentration factor from 1.84 to 1.5 can be effected by suitable tapering of the shells at the junctions and by providing increased radii at the fillets. E.E.B.

N65-25939# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
DETERMINATION OF THE SHAPE OF A FREE BALLOON: CONSIDERATION OF MATERIAL ELASTICITY Scientific Report No. 6
Justin H. Smalley 3 Dec. 1964 31 p refs *Its* Rept.-2704
(Contract AF 19(628)-2783)
(AFCRL-65-157; AD-614625)

Linear membrane theory is used to determine the effect of material elasticity on the stresses and shape of a free balloon which is originally inelastic. Two cases are considered: a zero superpressure natural-shape polyethylene balloon of taper-tangent design, and a superpressure Mylar balloon of tangent-harness design. Deformations and stress changes are small in both balloons, except that at the top of the natural-shape balloon, linear membrane theory does not apply and stress changes and deformations are not determined. Reference is made to a non-linear membrane theory which can be used to determine these parameters. Author

N65-25958# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
THE USE OF THE CRITICAL THICKNESS CONCEPT IN DESIGN
Robert N. Katz and Kenneth H. Abbott Dec. 1964 20 p refs
(AMRA-TR-64-51; AD-614094)

A brief review of the "critical thickness" concept is presented. Three actual examples of solid rocket motor case designs are then discussed. In the first example, fracture toughness and/or "critical thickness" were not taken into account, but the case proved adequate. In the second example, a design based on the success of the first case proved inadequate because of an increase in section thickness. In the third example, the "critical thickness" was properly considered and no brittle failure problem arose. After the discussion of these histories, a simplified technique for obtaining the critical thickness data required for adequate design is presented. Author

N65-25983# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
SLOW BEND-TENSION TEST CORRELATIONS OF SHORT BEAMS WITH SPECIAL REFERENCE TO THE CHARPY-TYPE SPECIMEN
John Nunes Dec. 1964 21 p refs
(AMRA-TR-64-45; AD-614095)

The maximum outer-fiber stresses of simply supported rectangular beams subjected to a concentrated load at midspan for various span-to-depth ratios were determined utilizing the Wilson-Stokes theory. It was found that at the elastic limit of the load-deflection curve, the maximum outer fiber longitudinal compressive stress of the unnotched Charpy specimen correlated well with the uniaxial tension test yield stress data. Also, the yield loads determined from the limit of the linear load-deflection curves of the notched Charpy specimens were found to be essentially equivalent to the unnotched Charpy yield-load data. Finally, it is shown that it is possible to calculate from uniaxial tension test data the maximum bending load of an unnotched centrally loaded, simply supported beam, provided the exponential relationships of stress and strain and the Wilson-Stokes theory are used. Author

N65-25996# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STRUCTURAL OPTIMIZATION OF FOAM-CORE AND HONEYCOMB-CORE SANDWICH CYLINDERS UNDER AXIAL COMPRESSION
A. Bruce Burns Dec. 1964 68 p refs
(LMSC-6-62-64-17; AD-612687)

Data for the optimum structural design of foam-core and squarecell-honeycomb-core sandwich cylinders under axial compression are presented in this report. For predicting the general mode of instability, the method recently proposed by Almroth is employed, which includes the effects of transverse shear deformations. This method also utilizes the upper and lower bounds to the critical buckling load, and an empirical factor applied to the difference between the two bounds. Although the data presented relate to sandwiches having facings of equal thickness and identical material the computer

programs developed to generate these data are capable of analyzing sandwiches wherein the facings are dissimilar with respect to thickness and/or material. The computer programs are presented in appendixes, along with a summary of information on the shear moduli for various sandwich configuration. It is shown that practical foam-core and squarecell-honeycomb-core constructions are possible at low loading indexes which are more efficient than conventional construction involving rings and stringers of rectangular cross section. At higher loading indexes, where the stresses in the sandwich facings approach the maximum permissible stress, these sandwich constructions show little superiority over conventional construction, and may even be less efficient. Author

N65-26047*# Republic Aviation Corp., Farmingdale, N. Y.
STRESS ANALYSIS OF A DOUBLY-CURVED SKIN WITH A FLARED NOZZLE PORT, PHASE V Annual Summary Report
I. U. Ojalvo, M. Newman, M. Goldberg, and N. Levine 15 May 1965 177 p refs
(Contract NAS8-2698)
(NASA-CR-63228; RAC-1452-6) CFSTI: HC $5.00/MF $1.00 CSCL 13M

An analysis to determine the stresses and deflections caused by comparatively small flared nozzle openings in large pressure vessels and an associated digital computer program are described. The structural problem is idealized as a shell of revolution with axis normal to a thin, shallow, parent shell which is not axisymmetrical. The midsurfaces of the two shells are assumed to mate at a common intersecting circle and the entire configuration is subjected to internal pressurization and membrane edge forces. Author

N65-26048*# Republic Aviation Corp., Farmingdale, N. Y.
STRESS ANALYSIS OF A DOUBLY-CURVED SKIN WITH A FLARED NOZZLE PORT, PHASE V User's Manual
I. U. Ojaluo 15 May 1965 28 p refs
(Contract NAS8-2698)
(NASA-CR-63229; RAC-1452-7) CFSTI: HC $1.00/MF $0.50 CSCL 13M

The operation of a digital program to determine the stresses and deflections of flared nozzles in doubly-curved thin, shallow, domes is described. The structural problem is idealized as a flared shell of revolution with axis normal to a thin, shallow, parent shell of double curvature. The midsurfaces of the two shells are assumed to mate at a common low, parent shell of double curvature (see Figure 1). The midsurfaces of the two shells are assumed to mate at a common intersecting circle and the entire configuration is subjected to internal pressurization and membrane edge forces. The sign convention used for deflections, rotations, forces, and moments is presented. The computer program consists of six separate parts which may be run in one machine pass but must be placed in consecutive numerical order, i.e. Parts 1, 2,...,6. Input for Part 1 follows the program deck for Part 1. Input for Part 2 follows the program deck for Part 2, etc., to Part 6. The input for Parts 2, 3, and 5 are identical. Part 6 differs in only one input card, as described in Section V. Therefore, input instructions for Parts 1, 2, and 3 only, are given in detail. Author

N65-26070# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering
ON LINEAR EQUATIONS OF ANISOTROPIC ELASTIC PLATES
Yi-yuan Yu Jan. 1964 13 p refs Submitted for Publication
(Contract AF 49(638)-1290)
(SR-1; AD-614132)

The generalized Hamilton principle and the associated variational equation of motion for linear and anisotropic elastic plates are deduced from their counterpart in general elasticity theory through expansion of the displacement and strain in infinite power series in the manner of Cauchy and Mindlin and by carrying out the subsequent integration in the direction of plate thickness. The Euler equations of the variational principle then give the complete system of plate equations of all orders as obtained by Mindlin by a different procedure. E.E.B.

N65-26084*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THOR-AGENA LONGITUDINAL MODE COMPUTATIONS Final Report
E. L. Stanton 10 Dec. 1964 204 p refs
(Contract NAS1-4535)
(NASA-CR-63368; SM-46346) CFSTI: HC $6.00/MF $1.25 CSCL 20K

In conjunction with planned vibration testing at the Langley Research Center, the first three longitudinal frequencies and mode shapes of their Thor-Agena test vehicle are predicted in this study for several test configurations. A bar idealization of structure is employed and the iterative procedure of Myklestad is used to obtain numerical solutions. These calculations are made with a standard Douglas program (DB 11) commonly used for such analyses. Author

N65-26088# Brown Univ., Providence, R. I. Div. of Engineering
EXPERIMENTAL AND THEORETICAL STUDY OF WAVE PROPAGATION AND VIBRATION PROBLEMS Final Report
J. Duffy et al 14 Apr. 1965 4 p refs
(Contract DA-31-124-ARO(D)-37)
(AROD-2571-4; AD-462855)

Plastic wave propagation and vibration phenomena in metals were studied using birefringent coatings and birefringent strips to measure specimen strains. The specimen consisted of a half inch diameter steel bar with a cemented strip of 1/8 inch Araldite. Difficulties were encountered with the coating in that the observed fringe order was very low. Other difficulties resulted from the superposed multiple reflections of the waves within the coating from the free surface and from the cemented surface. Birefringent strips were employed to measure strain immediately at the interface of the metal and plastic. Results were erratic because of small variations in temperature which produced variations in the material properties. To avoid the temperature variation problems, a new experiment was set up using a birefringent strip of Araldite with a low Young's Modulus. The setup was not sufficiently sensitive to give even one fringe during the passage of a plastic wave. R.N.A.

N65-26098# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace and Applied Mechanics
A NOTE ON VIBRATIONS OF A BEAM ON AN ELASTIC FOUNDATION
Morris Morduchow Mar. 1965 15 p refs
(Contract Nonr-839-(17)(FBM))
(PIBAL-901; AD-614072)

For cases in which the foundation modulus varies proportionately to the mass per unit length of the beam, the principal mode shapes of the free bending vibrations of a non-uniform beam will be exactly the same as without the elastic foundation, and a simple exact result for the effect of the foundation on the natural bending frequency in any mode is obtained. Extensions of the analysis and results for such cases are then made to obtain the exact effect of the elastic foundation on

torsional vibrations and on bending vibrations with damping and axial end loads. A general solution for forced bending vibrations is shown. When the foundation modulus does not vary exactly proportionately to the mass per unit length of the beam, a simple approximate result for the effect of the elastic foundation on the natural bending frequency in any mode is obtained by the Rayleigh method. Author

N65-26104# Oklahoma Univ., Norman. Graduate Coll.
ANALYSIS OF RESIDUAL STRESS IN BARS AND TUBES WITH CIRCULAR CYLINDRICAL ORTHOTROPY
Wayne A. Olson (M.S. Thesis) 1965 85 p refs
(AD-612250)

General equations are developed for determining residual stresses in bars and tubes with circular cylindrical orthotropy. Lack of complete knowledge of the elastic properties for a particular orthotropic material need not hamper efforts to determine residual stresses, since the experimental technique for the determination of these elastic properties is covered. Although the nature of the equations presented is somewhat complicated, particularly from the standpoint of performing the numerical computations, graphical solutions of these equations for some cases of importance are given as a function of dimensionless ratios. These are of considerable aid in reducing the effort in determining the numerical values of the residual stress components. E.E.B.

N65-26189 | Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF SYNTHESIS OF A CONFIGURATION OF ROD-LIKE STATISTICALLY DEFINABLE STRUCTURES OF MINIMAL WEIGHT
D. A. Matsyulyavichus *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 165–170 refs (See N65-26175 15-10)
CFSTI: $7.00

The problem of finding a rod-like structure of minimal weight for a system of point-nodes arbitrarily assigned in space in which constant external forces are applied, is investigated. In the general case the problem is reduced to minimization of a nonlinear functional for a linear system of limitations. For one particular case the problem is reduced to the general problem of linear programming. Author

N65-26251*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
A STUDY OF THERMO-STRUCTURAL DESIGN CONCEPTS FOR LIFTING ENTRY VEHICLES, PHASE II
J. Newell Washington, NASA, Jun. 1965 184 p refs
(Contract NAS1-3531)
(NASA-CR-240) CFSTI: HC $5.00/MF $1.25 CSCL 21B

This report contains the results of an investigation which was performed concerning the feasibility of various structural concepts for future space vehicles such as the HL-10 configuration. Various combinations of ablator and substructure were analyzed to survive the environments of ascent, space flight, and reentry at velocities between 26,000 and 36,500 feet per second. The concepts were applied to representative locations on the vehicle and evaluated in terms of thermal and structural peformance; weight, which is a measure of efficiency of performance; ease of fabrication, reusability and/or refurbishability; and fabrication and assembly costs. To aid in the evaluation, comparisons were made between double and single wall concepts. The merits of integrated wall construction were examined in conjunction with the double wall concept. The term "integrated wall" as applied herein refers to reliance on the load-carrying ability of the ablator material in the structural design of an ablator-substructure composite shell. Author

N65-26263# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugzeugbau
VIBRATION BEHAVIOUR OF AXIAL-SYMMETRICALLY LOADED THIN-WALLED CIRCULAR CYLINDERS UNDER DIFFERENT BOUNDARY CONDITIONS [SCHWINGUNGSVERHALTEN VON AXIALSYMMETRISCH BELASTETEN DUNNWANDIGEN KREISZYLINDERN BEI VERSCHIEDENEN RANDBEDINGUNGEN]
P. Seggelke 22 Dec. 1964 31 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-43) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 8 DM

The author develops a method of calculation for the determination of characteristic frequencies and the types of characteristic oscillation of isotropic thin-walled circular cylinder shells under different boundary conditions. The shells are statically loaded by axial load and radial pressure; in the state of rest, diaphragm stresses only are assumed to be present. The application of this process is shown with an example of axially loaded circular cylinder shells with clamped Author

N65-26264# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mülheim an der Ruhr (West Germany). Institut für Festigkeit
ON THE DYNAMIC STABILITY BEHAVIOR OF THIN ISOTROPIC CIRCULAR CYLINDRICAL SHELLS IN THE ELASTIC RANGE WITH TIME-DEPENDENT END CONDITIONS [UBER DAS DYNAMISCHE STABILITATSVERHALTEN DUNNWANDIGER ISOTROPER KREISZYLINDER IM ELASTISCHEN BEREICH BEI ZEITLICH VERANDERLICHEN RANDBEDINGUNGEN]
G. Kotowski Jan. 1965 18 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-01; DVL-363) Available from Zentralstelle für Luftfahrtdokumentation und Information (ZLDI), Munich: 33 DM

The following report concerns a nonlinear system of partial differential equations and end conditions, describing the motion and the dynamic stability of circular cylindrical shells under time-dependent end conditions. This system is derived and then linearized. Solving methods and several solutions for given end conditions are then registered for shells with hinged edges. Expecially the case with vanishing radial displacement at the end is discussed. The numerical results obtained by other authors are supplemented. Natural frequencies and the ratios of the amplitudes are determined under constant axial compression. For a given shell with vanishing radial end displacement the axisymmetric buckling motion is calculated under a rectangular impact. Author

N65-26283# Douglas Aircraft Co., Inc., Santa Monica, Calif. Structural Mechanics Section
THOR LONGITUDINAL OSCILLATION STUDY Final Report
W. F. Davis, D. L. Keeton, and T. F. Lynch Mar. 1964 129 p
(Contract AF 04(695)-274)
(SM-45009; AD-460911)

This report presents the results of a study program initiated to define and analytically describe the longitudinal oscillations manifested in the Thor-Agena space vehicle. The method consisted of describing vehicle subsystems by transfer functions, then combining them into a closed loop system. Standard control system analysis techniques were then used to predict stability and to define the nature of the oscillations. Author

N65-26286# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Astronautics Div.
METHODS IN STRUCTURAL DYNAMICS FOR THIN SHELL CLUSTERED LAUNCH VEHICLES

J. S. Keith et al Wright-Patterson AFB, Ohio. Flight Dyn. Lab., Apr. 1965 759 p refs
(Contract AF 33(657)-9146)
(FDL-TDR-64-105; AD-463571)

A general methodology in Structural Dynamics based on the use of generalized coordinates is presented. These general methods are demonstrated by analysis of some of the problems of slender, conventional, launch vehicles. Applications of the general methodology are also given for complex configurations employing thin shell tanks in clustered arrangements. The methods of structural analysis and vibration analysis that are presented are not restricted to any particular geometry and apply to any complex redundantly coupled structure. To further demonstrate the general methods, a vibration analysis of the clustered Saturn I launch vehicle is presented. Author

N65-26299# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
GYRO TORQUE DUE TO MAGNETIC ATTRACTION BETWEEN FLEX LEADS
Lawrence Sher Jan. 1965 59 p Revised
(Contract AF 33(615)-2243)
(E-1706; AD-613227)

The steady-state torque exerted on a gyroscope float due to the magnetic interaction of the motor excitation currents flowing through the flex leads is computed. The analysis is performed for two different configurations of flex leads. Author

N65-26369# McDonnell Aircraft Corp., St. Louis, Mo.
CONCEPTUAL FLUTTER ANALYSES Quarterly Report, 1 Jun.–1 Sep. 1964
C. H. Perisho 1 Oct. 1964 15 p
(Contract NOw-64-0332-c)
(BNW-236-46394; AD-461618)

Investigations were made of the applicability of the conceptual approach through comparison of predicted and experimental flutter behavior for a broad range of simple systems. A literature search was undertaken to obtain experimental flutter results and measured study-flow aerodynamic data for use in validating the analyses made in the study. Two degree of freedom flutter analyses were conducted for a number of rigid surface pitch/plunge and root roll/pitch configurations. Comparison of these data and collected experimental flutter behavior of these systems indicates the conceptual flutter technique to be valid. Based on the close agreement of calculated and experimental two degree of freedom flutter data, analyses have been initiated on uniform cantilever surfaces possessing spanwise flexibility. Two techniques of rational representation of the aerodynamics have been employed: the exact solution of the Partial Differential Equation of Motion; and two variations of a Rayleigh-Ritz solution, which differ in the terms considered for evaluation of the circulatory lift. M.W.R.

N65-26370# Alpha Research and Development, Inc., Blue Island, Ill.
INTERFACIAL INTERACTION IN COMPOSITE STRUCTURES Year End Report, 12 Feb. 1964–31 Mar. 1965
Robert L. Patrick and Eli A. Port [1965] 66 p refs
(Contract NOw-64-0413-c)
(AD-464508)

A program has been initiated to examine the interfacial interaction of composite structures, specifically with glass-resin composite structures. This program, utilizing classical surface chemical techniques, is investigating the role of water in interfacial failure. The experimental approach considers the failure of the bond in the interphase as the major objective rather than the failure of the substrate through stress corrosion. The second portion of the program will be concerned with the investigation of the role of coupling agents and their method of action. The program during the first year has been concerned with developing apparatus suitable for maintaining a low water vapor content atmosphere while allowing experimentation to be carried out. An anhydrous cell which contains continuous glass rod drawing apparatus has been fabricated. Anhydrous glass rod has been prepared and has been utilized in initial experiments to obtain "base-line" information. Tritiated water has been used as a convenient "handle" to observe rates of hydration of the surface, capability of dehydrating glass surfaces by thermal means, rates and location of diffusion through model composite systems, and the location of water on the surface. A radiographic emulsion technique, as well as scintillation counting, has been utilized in this investigation. Author

N65-26438# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AGENA TANK MODAL TEST STRUCTURES STUDY
R. S. Albert 17 Jul. 1964 65 p refs
(Contract AF 04(695)-191)
(SS/788/5522; LMSC-A666971; AD-461821)

This Structures Study presents the results of the Agena S-01B tank modal test and a comparison of these results with analytical calculations and measured flight data. The scope of the test, as defined in the test objectives, was to determine the validity of the current techniques used to describe the dynamic behavior of the Agena propellant tanks. These techniques predict dynamic loads lower than those derived from flight data. In addition, it was desired to have test data available for checking flight measurements and, in the event the current analysis proves unsuitable, for subsequent development of a new analytical approach. The test program, performed as described in the test procedure, was scheduled to meet the test objectives. The test results indicate good frequency agreement between analysis and test measurements for the first mode for the full flight condition. However, differences in the mode shapes are such that significant error exists between the pressure calculations and the test measurements. The pressure calculations are 25% lower than measured in test. Subsequent test conditions, with increased ullage volumes, gave increasingly worse comparisons. The analytical model, for the full condition, is capable of predicting the loads as measured in the test in the frequency range of the coupled Agena and booster. However, neither the analytical loads nor the test loads approach the value of loads computed from flight data, which are 21% higher. The possibility exists that differences between test loads and flight loads can be explained by lack of simulation of exact flight conditionns during the test. Author

N65-26466# Royal Aircraft Establishment, Farnborough (England).
POTENTIALITIES OF RESEARCH INTO DETAIL DESIGN
J. Taylor London, Min. of Aviation, Jun. 1948 15 p refs
(RAE-STRUCT-29)

An examination is made of structural design to show possible fields of research. Attention is focused on a particular aircraft which has low structure weight by present standards. The structure is analysed in two stages; first an ideal structure with the required strength and stiffness, and secondly additional structure necessary for joints, stabilisers and oversize materials, and also an allowance for ignorance of precise stress distributions. The ideal structure is shown to weigh a quarter of the total structure weight. The remainder needs research in many fields. It is estimated that a few years research should yield a 30% reduction in total structure weight. Author

N65-26573# Automation Industries, Inc., Boulder, Colo.
CORRELATION STUDIES BETWEEN THREE-DIMENSIONAL ULTRASONIC SCANNING AND STANDARD IMMERSED ULTRASONIC Technical Report, May 1963–15 Nov. 1964
G. L. Cross and H. R. Ellerington Wright-Patterson AFB, Ohio. AF Mater. Lab., Mar. 1965 61 p refs
(Contract AF 33(657)-11283)
(AFML-TR-65-84; AD-464732)

The work effort under Contract AF33(657)-11283 was designed to provide correlation studies between standard ultrasonic inspection techniques, radiography, and isometric ultrasonic techniques in plates, castings, and weldments to determine how these three inspection methods compare in sensitivity and ability to recognize different types of defects. The Isometric Scan System showed very good results on some samples; however, it is optimum on smooth surfaces and thicknesses over 1 inch. The Delta Configuration correlated better with the X-rays than any other methods evaluated. All of the ultrasonic inspection techniques can locate discontinuities; but, identification and classification of the nature of the defects is difficult. Author

N65-26603# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
APPLICATION OF THE MATRIX DISPLACEMENT METHOD TO THE LINEAR ELASTIC ANALYSIS OF SHELLS OF REVOLUTION
John H. Percy, Theodore H. H. Pian, Dhirendra R. Navaratna, and Stanley Klein Jan. 1965 84 p refs
(Contract AF 04(694)-427)
(ASRL-TR-121-7; AD-615121)

This report describes the application of the matrix displacement method to the linear elastic analysis of shells of revolution. The shell is idealized as a series of conical frusta, joined at nodal circles. The use of this idealization to handle asymmetric deformations is demonstrated. It is shown how approximations to the mass and stiffness matrices may be consistently derived; these may then be used to solve both static and dynamic problems. The effect on the results of static analyses of improving the approximation to the stiffness matrix is demonstrated and discussed. Results of static analyses of several shell configurations are presented and these are compared with solutions by other methods. Author

N65-26604# Joint Publications Research Service, Washington, D. C.
CALCULATION OF DISTURBING FORCES CAUSED BY HYDRODYNAMIC IMBALANCE OF THE SCREW PROPELLER
Y. S. Akulayev 25 Jun. 1965 7 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 1, 1965 p 18–20 refs
(JPRS-30-797; TT-65-31341) CFSTI: $1.00

Calculations of disturbing forces due to deviations of central angles between blades are discussed for the case where an element of a screw propeller blade, which upon streamlining by a flow of water at a velocity encountered at a certain angle of attack is subject to the action of an uplifting force and profiled resistance. Functions of the eddy theory are used to obtain the equations of resistance to blade rotation, and for the relative forward advance. This permits calculations of the propeller resistance to rotation as a function of the relative advance for several blade cross sections under the appropriate change in step values. The total value of the hydrodynamic imbalanced force with a first-order frequency is found by a summation of the absolute values of imbalance forces due to the out of step position and deviations of central angles between blades. G.G.

N65-26605# Joint Publications Research Service, Washington, D. C.
CHARACTERISTICS OF FIBERGLASS SHIP VIBRATIONS
V. D. Popov and S. V. Sochinskiy 25 Jun. 1965 12 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 2, Feb. 1965 p 17–20 refs
(JPRS-30-798; TT-65-31342) CFSTI: $1.00

To determine the frequencies of free vibrations of a fiberglass hull, calculations were made of the forced vibrations without accounting for resistive forces. When shear was not taken into account, errors of between 15% and 50% occurred. It was found that five tones of free vibrations of fiberglass ships and only two of steel ships fell within the same frequencies of the disturbing force, that is, up to 1000 vibrations/minute. For frequencies of disturbing forces higher than the third or fourth deformational tone, shear becomes the main factor governing the amplitude of the free vibration. The increased damping characteristics of the fiberglass hull makes calculations of free vibrations of higher tones inadvisable. At high frequencies, the role of design damping becomes very important. M.W.R.

N65-26607# Hayes International Corp., Huntsville, Ala.
PLANE THERMAL STRESS ANALYSIS OF THICK-WALL CYLINDERS, VOLUME II: TEMPERATURE DISTRIBUTION OF FORM (T = Rcos NΘ)
Floyd J. Stanek 15 Jan. 1964 37 p refs Sponsored in part by AEC
(HIC-1-1564-3)

This volume presents the necessary formulas for plane thermal stress analysis of the thick-wall cylinder when the temperature function is of the form $T = R \cos n\theta$ where R is a function of the radial coordinate only and n is an integer. The cylinder may be in a condition of plane strain or a condition of plane stress. The external stresses at each of the two cylindrical surfaces are zero. The necessary formulas are presented in Part I. The procedure for the application of these formulas is then explained and illustrated with several examples. The derivation of these formulas is presented in Part II by each of two methods: 1. by the classical theory of elasticity, and 2. by complex theory. The derivation by complex theory illustrates the application of the complex representation of the general equations of plane elasticity. It is the intent of this volume to bridge the gap between theory and design (Part I) and to aid the advancement of the technology in elasticity (Part II). It is not necessary to understand the derivation in order to understand the application. Author

N65-26612# Aerospace Corp., San Bernardino, Calif. Technology Div.
ON EXACT SIMPLIFICATIONS OF THE STRAIN ENERGY EXPRESSION FOR PLATES AND CIRCULAR CYLINDRICAL SHELLS
R. M. Jones May 1965 17 p refs
(Contract AF 04(695)-469)
(TDR-469(S5810-12)-3; BSD-TR-65-293; AD-464541)

The second stress invariant, $\sigma_x\sigma_y - \tau_{xy}^2$, and the usual approximation to the change in Gaussian curvature, $w_{xx}w_{yy} - w_{xy}^2$, appear in the membrane and bending strain energy expressions for plates and circular cylindrical shells. The term $w_{xx}w_{yy} - w_{xy}^2$ is shown herein to make no contribution to the equilibrium equations under any circumstances, nor to the boundary conditions if the ends of the deformed shell are geodesics. If w is expanded in a particular series of orthogonal functions, the term $w_{xx}w_{yy} - w_{xy}^2$ makes no contribution whatever to the strain energy. In addition, if a stress function exists, the term $\sigma_y\sigma_y - \tau_{xy}^2$ also makes no contribution

to the strain energy and, hence, cannot contribute to the equilibrium equations and the boundary conditions. These simplifications are especially useful in the common Rayleigh-Ritz approach in which the total potential energy is made stationary after a suitable deflection configuration is chosen, but are, by no means, restricted to that approach. The present results apply to plates by virtue of the fact that the surface of a circular cylindrical shell can be developed from that of a plate. Author

N65-26626*# Astro Research Corp., Santa Barbara, Calif.
THE ROTORNET: A HIGH-PERFORMANCE HYPERSONIC DECELERATOR FOR PLANETARY ENTRY
A. C. Kyser Washington, NASA, Jun. 1965 94 p refs
(Contract NAS7-272)
(NASA-CR-247) CFSTI: HC $3.00/MF $0.75 CSCL 22B

This report describes the Rotornet, a new type of aerodynamic decelerator proposed for space missions requiring entry into planetary atmospheres. The basic element of the Rotornet is a large, light-weight, flexible, filamentary disk which is attached at its center to a hub on the nose of the entry vehicle, and stiffened, during operation, by a high spin rate. This concept makes possible the use of very large surface areas for aerodynamic braking (W/C_DA less than 1 lb/ft^2). For such low values of W/C_DA, the maximum heating rates, even for earth entry at superorbital speeds, are well within the capability of high-temperature filamentary structural materials to reject heat by radiation. Since no non-structural thermal-protection material is required, the decelerator weight can be reduced to a few percent of the payload weight. The mechanical and operational characteristics of the Rotornet are discussed, including its behavior in a hypersonic windstream, and its potential performance as a re-entry decelerator. It is shown that for a given set of entry conditions the ratio of rotor mass to payload mass is proportional to disk radius, which, in turn, is proportional to the cube root of the total vehicle mass; for a 10-g ballistic entry from earth orbit, a rotor weight of about 200 lbs is sufficient for a payload of 10,000 lbs. Finally, the possibilities are discussed for future use of the Rotornet as a decelerator for more severe entry missions. Author

N65-26629*# Martin Co., Denver, Colo.
COMPILATION OF SHOCK, VIBRATION, AND ACOUSTIC DATA FROM TITAN VEHICLES. VOLUME II: TITAN I ACOUSTIC AND VIBRATION DATA
Jan. 1965 636 p
(Contract NAS1-4312)
(NASA-CR-62001; CR-64-86, Vol. II) CFSTI: HC $9.36/MF $3.00 CSCL 20K

Descriptions and locations of each vibration transducer and an inboard profile showing component and transducer locations are presented. A summary of all vibration data is shown in tabled form. The measured overall rms vibration levels, as well as the power spectral density plots and time histories are also presented. G.G.

N65-26642*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FREE AND FORCED VIBRATIONS OF CANTILEVER BEAMS WITH VISCOUS DAMPING
Floyd J. Stanek Washington, NASA, Jun. 1965 51 p refs
(NASA-TN-D-2831) CFSTI: HC $3.00/MF $0.50 CSCL 20K

The equations of motion for the free and the forced vibrations of a cantilever beam with viscous damping are given to include formulas for the bending moment, lateral shearing force, deflection, velocity, and acceleration at any desired point of the beam for any chosen time. The coefficient of viscous damping was assumed to be constant throughout the length of the beam. Further, it was assumed that during free vibration the free end of the beam was initially displaced some arbitrary distance and then released. The first five roots are tabulated for the mode of vibration and natural frequency. Also, it was assumed that during forced vibration the normally fixed end of the cantilever beam was subjected to a lateral displacement of the form $y = Y_0 \sin \omega t$ and that zero slope was maintained. The equations of motion are presented in dimensionless form; the derivations, design curves for some of the parameters, and a set of dimensionless results for each of several sample examples are included. E.E.B.

N65-26648*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF HIGH-VELOCITY FLUID FLOW ON THE BENDING VIBRATIONS AND STATIC DIVERGENCE OF A SIMPLY SUPPORTED PIPE
Harold L. Dodds, Jr. and Harry L. Runyan Washington, NASA, Jun. 1965 12 p refs
(NASA-TN-D-2870) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The present experimental study is concerned with the effect of high-velocity fluid flow on the static and dynamic characteristics of a simply supported pipe. The frequency variation of the bending vibrations as a function of fluid velocity, as predicted by G. W. Housner, was verified experimentally. In addition, the critical fluid velocity at which the system becomes statically unstable was also verified. Author

N65-26655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF VACUUM ON THE FATIGUE AND STRESS-RUPTURE PROPERTIES OF S-816 AND INCONEL 550 AT 1500°F
Alfred J. Nachtigall, Stanley J. Klima, John C. Freche, and Charles A. Hoffman Washington, NASA, Jun. 1965 29 p refs
(NASA-TN-D-2898) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The relative effects of vacuum (10^{-4} to 10^{-5} mm Hg) and air environments on the axial tensile fatigue (cyclic- to mean-stress ratios of 0.667 and 0.125) and stress-rupture properties of a cobalt-base alloy (S-816) and a nickel-base alloy (Inconel 550) were investigated at 1500° F. The range of mean stress was from 15 000 to 40 000 psi. Life in vacuum was generally greater than life in air for both alloys in both fatigue and stress rupture. This improvement was fairly constant over the entire stress range for S-816, but a convergence was observed at the lower stresses for Inconel 550. The convergence indicates that long time elevated temperature tests in air may not always adequately describe superalloy performance in fatigue or stress rupture under vacuum. Thus, to avoid miscalculations in space vehicle component designs, which could result in premature failures, superalloys should be tested for long time periods in vacuum to more nearly simulate a space environment. Failures at the highest cyclic- to mean-stress ratio were generally transgranular. As the ratio was decreased and a stress-rupture-type test was more nearly approached, a combination of transgranular and intergranular failure modes was observed. Stress-rupture failures were generally intergranular. Oxide penetration varied with test life for both materials but did not appear to be affected by either mean or alternating stress. Electron beam microprobe analyses indicated that chromium, of all the elements checked, showed by far the greatest degree of depletion after long test times for both alloys. Chromium depletion was observed in S-816 in both vacuum and air and in Inconel 550 in air. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-25574# Intermountain Research and Engineering Co., Inc., Salt Lake City, Utah.
CONSTANT VELOCITY JETS FOR QUANTITATIVE ULTRA-HIGH VELOCITY CRATERING STUDIES Final Report, 5 Jun. 1963–28 Jan. 1965
Douglas H. Pack Mar. 1965 130 p refs
(Contract AF 08(635)-3668)
(ATL-TR-65-24; AD-462521)

Experiments were carried out to produce a constant velocity jet from shaped charges. Tests were conducted in atmosphere and at reduced pressures. Liner geometries, types of explosive, and wave shaping techniques were varied systematically to produce an elongated jet which approached a velocity of 14.0 km/sec. Author

N65-25576# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.
ANALYSIS OF HEAT TRANSFER IN A TWO-LAYER SLAB: LINEAR FLUX ON ONE SURFACE AND ZERO FLUX ON OTHER SURFACE
M. Elena Franklin and Albert C. Giere 31 Mar. 1965 62 p refs
(NAVWEPS-8301; AD-461802)

The one-dimensional time-dependent equation of heat conduction is solved for an infinite two-layer slab. The layers are in perfect thermal contact. The outer surface of the first layer receives a heat flux proportional to the temperature difference between it and a constant external source of heating; the outer surface of the second layer does not have any heat flux leaving it. A formal application of the Laplace transform gives an analytic solution for the temperature distribution in the classical form of an infinite series. Roots of a transcendental equation needed for the series and a computer program to determine the roots are included. Author

N65-25577# Aeronutronic, Newport Beach, Calif. Chemistry Lab.
THERMODYNAMIC PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS Fourth Quarterly Letter Report, 15 Jan.–15 Apr. 1965
D. L. Hildenbrand [1965] 5 p
(Contract AF 49(638)-1397; ARPA Order-317)
(QLR-65-7; AD-461734)

Mass spectrometer observations of the vapor species in the Zr–F system established the appearance potentials in the Zr–CaF_2 system as: ZrF_2^+, 12.0 eV; ZrF_3^+, 7.5, and 14.5 eV; Ca^+, 6.0 eV; and CaF^+, 6.0 eV. Measurements of intensities 3 volts above threshold over the range 1665° to 1747° K were used to calculate the equilibrium constants for the reactions

(1) $Ca(g) + ZrF_4(g) = CaF(g) + ZrF_3(g)$ and
(2) $2Ca(g) + ZrF_4(g) = 2CaF(g) + ZrF_2(g)$

Third law calculations combined with heat of formation data yielded $\Delta Hf_{298} = -265 \pm 5$ kcal/mole for $ZrF_3(g)$, and $\Delta Hf^\circ_{298} = -1.45 \pm 5$ kcal/mole for $ZrF_2(g)$, and subsequently $\Delta Hf^\circ_{298} \cong 14$ kcal/mole and $D^\circ_0 \cong 6.5$ eV for ZrF(g). The vapor pressures of the chlorides and fluorides of Mg, Ca, Sr, and Ba were measured by the torsion-effusion method. From the reproducibility of the second-law heats and the agreement between calculated and experimental entropies tentative values for the entropies of gaseous dihalides were calculated. All electronic components to be used in the beam-chopping experiments were tested and found satisfactory. Some thermochemical data on the Zr-F system were also obtained. G.G.

N65-25584# Atomic Energy Establishment, Winfrith (England). Reactor Development Div.
AN EXPERIMENTAL INVESTIGATION INTO THE RELATIONSHIP BETWEEN BURN-OUT AND FILM FLOW-RATE IN A UNIFORMLY HEATED ROUND TUBE
R. Staniforth, G. F. Stevens, and R. W. Wood Mar. 1965 26 p refs
(AEEW-R-430) HMSO: 4s

Previous work on forced convection burnout with Freon 12 at 155 lb/in^2 (abs) produced data so similar to data for water at 1000 lb/in^2 that it was reasonable to suppose that the same mechanism of burnout applied to both fluids. This report presents further work with Freon 12 in which the flow rate of liquid along the inner wall of a heated round tube is measured at various flux levels up to burnout. The evidence is consistent with a simple picture of burnout in which the liquid film on the wall evaporates until it becomes so thin as to effectively disappear. The film thickness is influenced by entrainment and by deposition of liquid from the core, but it is not possible at present to distinguish between these effects. There is an abundance of liquid present in the channel other than the liquid on the wall, indicating potential in artificially reinforcing the liquid film and so increasing the burnout heat flux. Author

N65-25597*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXTENSION OF AN ANALYSIS OF PERIPHERAL WALL CONDUCTION EFFECTS FOR LAMINAR FORCED CONVECTION IN THIN-WALLED RECTANGULAR CHANNELS
Joseph M. Savino and Robert Siegel Washington, NASA, Jun. 1965 34 p refs
(NASA-TN-D-2860) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The peripheral heat conduction within each wall was formulated in terms of an integral equation coupled with the energy equation in the fluid. The solutions were evaluated for various aspect ratios and wall conductivities. A rectangular duct was considered with uniform heating and peripheral conduction in the broad walls. When the short unheated walls were allowed to conduct heat, but no heat was allowed to flow around the corners within the walls, the following changes were found as compared with a duct with nonconducting short walls: (1) For moderate values of the wall conductivity, the temperature distribution along the unheated wall became almost uniform and (2) for duct aspect ratios less than 5, the conduction in the unheated wall lowered the dimensionless temperatures along the heated wall. The decrease in the difference between dimensionless wall and bulk temperatures was from 15 to 30% depending on the conductivity and aspect ratio. For larger aspect ratios, the temperatures along the heated wall were decreased only a small amount for a region near the corner. A square duct was considered, heat conducting and uniformly heated on all walls. Moderate values of wall conductivity produced substantial reductions in the peak temperatures that occurred at the duct corners. For high values of the wall conductivity, the duct approached the known case of constant peripheral wall temperature with uniform heat addition in the flow direction. Author

N65-25727# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
SHOCK TUBE GAS DYNAMIC CHARTS, PART 2: MARTIAN ATMOSPHERES (MODELS G, H, I, J, AND K)
K. Heron 21 May 1965 124 p refs
(RAD-TM-65-23)

Equilibrium gasdynamic charts suitable for use in conjunction with shock tube experiments are presented for three gas mixtures which are thought to represent the Martian atmosphere. The three mixtures are 65 percent CO_2 + 35 percent A (Atmospheres G&H); 43 percent CO_2 + 32 percent A + 25 percent N_2 (Atmosphere I); 11 percent CO_2 + 13 percent A + 76 percent N_2 (Atmospheres J&K). The charts cover a range of shock velocities (U_s) corresponding to stagnation temperatures greater than 4500° K and stagnation pressures greater than 0.1 atmosphere. Incident, reflected and standing wave, and stagnation point calculations are plotted for each mixture. A simulation plot of the stagnation point conditions in flight and in the shock tube is also presented. Author

N65-25751# United Aircraft Corp., East Hartford, Conn. Research Labs.
LAMINARIZATION OF NOZZLE WALL BOUNDARY LAYERS AS A MEANS OF REDUCING HEAT FLUX Quarterly Progress Report No. 3, 1 Jul.–30 Sep. 1964
R. L. O'Brien and P. E. Demarest Oct. 1964 50 p refs
(Contract AF 04(611)-9576)
(C910100-15; AD-460927)

Analysis of the initial growth over the boundary layer development surface upstream of the boundary layer suction slot was performed for the range of throat Reynolds numbers of interest. This included the effects of the boundary layer tripping device which was installed in the test rig to insure the turbulence boundary layer approaching the suction slot. The turbulent heat transfer to the test nozzle was analyzed to determine the effect of wall temperature on the theoretical turbulent Stanton number. An increase in turbulent Stanton number with wall cooling was shown. Free stream turbulence level measurements were obtained at two stations upstream of the suction slot. Measurements were made both with and without the turbulence generators installed in the tunnel. Nozzle wall heat transfer and static pressure distributions were obtained both with and without boundary layer bleed at the suction slot station. Author

N65-25777# Rensselaer Polytechnic Inst., Troy, N. Y.
[THERMODYNAMICS RESEARCH]
J. W. Bursik and B. R. Onuf Jun. 1963 66 p refs
(Grant DA-TC-44-177-G6)
(TR-AE-6303; AD-612787)

For a number of important substances a new thermodynamic function is shown to be linear with temperature in the liquid-vapor region. This linearity leads to a compact method of representing the variation of the Gibbs function with temperature. Author

N65-25861# Naval Ordnance Lab., White Oak, Md. Environment Simulation Div.
THE EFFECT OF SINUSOIDAL RIPPLE CURRENT UPON THE TEMPERATURE DIFFERENCE ACROSS A THERMOELECTRIC COOLING DEVICE
Thomas R. Mc Knight Mar. 1965 91 p refs
(NOLTR-64-4; AD-612506)

Thermodynamic considerations of the thermoelectric phenomena responsible for the performance of cooling devices were used to derive a general equation that relates the zero heat load temperature difference across the hot and cold junctions of a thermoelectric device as a function of the driving electrical current. This equation was modified to include the effect of a sinusoidal ripple current superimposed upon the basic dc level. To check the equation's accuracy, a practical solid state cooling device was operated with smooth dc current upon which a controllable sine wave ripple current was superimposed. The effect of various ripple levels upon the temperature difference across the two junctions was observed and compared with that predicted by theory. Agreement between theoretical equations and experimental data was good in lower current ranges, but poor at higher current values. Consideration of the temperature dependence of the thermoelement resistivity yielded a more accurate representation of the experimental curve. It was concluded that the use of mean values of the thermoelectric properties in the theoretical equation produced sufficient accuracy at the lower current levels where practical cooling devices are normally operated. The effect of ripple was determined to be a decrease in the attainable temperature drop across the device at a particular current level. The decrease was considerable at the higher operating currents and ripple levels. However, the device was able to tolerate ripple levels of as high as 50% of the basic dc component without significant effect on the temperature difference at the lower driving currents corresponding to the increasing portion of the cooling curve. Author

N65-25889# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
IGNITION CHARACTERISTICS OF FUELS AND LUBRICANTS Summary Report, 1 Jan.–31 Dec. 1964
Joseph M. Kuchta and Ralph J. Cato Mar. 1965 57 p refs
(Contract DO-33(657)-63-376)
(AFAPL-TR-65-18; AD-613050)

Hot surface ignition temperature data are presented for n-hexane, n-octane, n-decane, JP-6 jet fuel and aircraft engine oils MIL-L-7808 (0-60-18) and H-1026 in various oxygen-nitrogen atmospheres (2.5 to 100 volume percent oxygen) under stagnant or near-stagnant flow conditions. Minimum ignition temperatures were found to increase with decreasing oxygen concentration. In vessel ignitions, these temperatures increased with decrease in fuel contact time and with increase in surface area/volume ratio. In wire ignitions, the minimum ignition temperatures increased with decrease in wire diameter, length/diameter ratio, and initial mixture temperature. Expressions have been developed to define the ignition temperatures as a function of the above pertinent variables. Hot gas ignition temperatures of the above combustibles were also found to vary with the heat source diameter, for 1/8, 3/8 and 1/2-inch diameter jets. Furthermore, they do not differ greatly from hot surface ignition temperatures for comparable heat source diameters. The hot gas jet temperatures required to produce "hot" flames and pseudo or "cool" flames varied noticeably more than did the corresponding heat flux values. In oxidation studies with n-octane vapor air-mixtures, rates of pressure rise were found to vary as the 0.38 power of the fuel concentration (5 to 30 volume percent) and as the 1.4 power of the initial total pressure (0.6 to 13 psia) at temperatures between 428° and 536° F. The temperature dependency of the rates in these studies was similar to that obtained in the ignition temperature experiments. Author

N65-25900# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics
MOTION OF THE DETONATION PRODUCTS BEHIND PLANE AND SPHERICAL DETONATION WAVES IN SOLID EXPLOSIVES
H. H. Calvit 30 Nov. 1964 23 p refs Sponsored by the Ballistic Res. Labs., Aberdeen Proving Ground, Md.
(TR-3; AD-613016)

The behavior of explosive gases behind a plane and spherical detonation wave in a condensed explosive such as solid Pentolite is examined. The analysis is numerical and considerable detail is given to the development of the computer programs. The boundary conditions are obtained from the analysis of Pentolite which also furnishes the equation of state for the explosive products. Comparison is made with the classical mathematical results based on a similarity assumption. Since the report deals mainly with the numerical aspects of the solution of the detonation problem only the essential classical mathematical analysis is presented. E.E.B.

N65-25947# General Applied Science Labs., Inc., Westbury, N. Y.
THE IGNITION OF FLOWING HYDROCARBON-AIR MIXTURES BY A HYDROGEN PILOT FLAME
J. A. Schetz and J. Jannone Apr. 1964 30 p refs Sponsored by AF
(AD-460904)

This report is concerned with an analytical study of the mechanism of ignition of a flowing hydrocarbon-air mixture by a hydrogen pilot flame in fully turbulent flow. Particular attention is directed to igniting such a mixture under static conditions precluding spontaneous thermal ignition. It is shown that a jet of a combustible mixture at a temperature sufficient to initiate reaction with the free stream air provides a more effective ignition source than a jet of inert gas at a considerably higher initial static temperature. Author

N65-25987# Bell Aerosystems Co., Buffalo, N. Y.
THERMAL RADIATION OF HIGH-TEMPERATURE COMBUSTION PRODUCTS Final Technical Report, 2 Dec. 1963–31 Dec. 1964
T. G. Rossmann Feb. 1965 46 p refs
(Contract AF 49(638)-1287)
(Rept.-9139-933002; AD-612698)

Emission radiometry and spectroradiometry were used to obtain measurements of the spectral distribution and magnitude of radiation from a flame zone containing CO at a theoretical partial pressure of 0.61 atm and a theoretical temperature of 3324° K. Preliminary quantitative results found an emitting path length of 2 inches and a vertical height of the radiation zone of less than 0.2 inches. A transmission spectrogram was obtained with the flame extinguished, but did not correspond to the emission band due to absorption of glower radiation by CO_2. An appendix describes in detail the main components of the experimental apparatus; namely, the spectrometer, source optics, burner, and the N_2 purge required to remove air from the apparatus. G.G.

N65-26023*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF SOLAR PANEL EFFECT ON LOUVER PERFORMANCE
Raymond A. Becker 1 Jun. 1965 16 p refs
(Contract NAS7-100)
(NASA-CR-63385; JPL-TR-32-687) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The influence which a solar panel exerts on the thermal performance of an array of temperature control louvers is investigated analytically in this Report. Although the analytical results apply specifically to the *Mariner C* configuration, many of the concepts included in the analysis are valid for other spacecraft geometries. The algebraic equations are formulated and solved yielding results which are presented in graphical form. The solar panel was found to have a significant negative effect on the thermal performance of the louvers, but the *Mariner C* configuration is such that this effect can be minimized. The technique for minimization is also presented. Author

N65-26031# British Internal Combustion Engine Research Association, Slough (England).
COMBUSTION IN DIESEL ENGINES Quarterly Technical Summary Report No. 1, 1 Aug.–31 Oct. 1964
W. S. May and W. P. Mansfield 18 Nov. 1964 6 p
(Contract DA-91-591-EUC-3488)
(AD-461193)

Ignition delay for combustion engines was reduced from 16 to 11 1/2 degrees crank at 1250 rpm, and from 28 to 18 degrees at 1950 rpm by low temperature fuel sprays of 21% and 14%, respectively, of the total fuel supplied into the engine intake. Total fuel consumption increased up to 15% at low speed with intake spray, but only 3% at high speed. A 4 × 0.35 mm nozzle with conventional injector and jerk fuel pump gave the best fuel consumption at engine runs of 1250, 1600, and 1950 rpm, but a 2 × .5 nozzle showed a much lower rate of cylinder pressure rise. Lower rates of pressure rise were also obtained with 3 × .5 and 3 × .4 nozzles. These results confirmed that the penetration of the spray determines the control of combustion. A 3× .5 mm nozzle in conjunction with a larger fuel pump element and increased air flow carried a load of 1600 rpm with a maximum pressure rise of 90 psi/degree crank using a 5% intake fuel spray. A quiet running condition was obtained at a fuel consumption of .470 lb/bhr hr. G.G.

N65-26052# United Aircraft Corp., East Hartford, Conn. Research Labs.
LAMINARIZATION OF NOZZLE WALL BOUNDARY LAYERS AS A MEANS OF REDUCING HEAT FLUX Monthly Progress Report, 1 Aug.–31 Aug. 1964
R. L. O'Brien 15 Sep. 1964 17 p
(Contract AF 04(611)-9576)
(C910100-13; AD-460953)

During the subject reporting period tests were begun with the heat exchanger and the short throat radius test surface configuration installed in the tunnel. The previously reported discrepancies in the measured boundary layer weight flows at the suction slot location were traced to a leak at a joint in the test surface upstream of the boundary layer removal plenum. A quick fix was made and data were obtained at a total temperature of 70 F. A permanent fix has been completed which will permit testing up to 400 F. The heat exchanger was checked out with liquid nitrogen coolant flow at a total temperature of 70 F. The results of this checkout indicated that the heat exchanger is not operating at its rated effectiveness. The data obtained to date seem to indicate that part of the liquid nitrogen flow within the heat exchanger is bypassing the internal coolant flow slots. This could occur only if the internal weld between the nitrogen inlet plenum and exhaust chamber were cracked. It was not possible to check that weld after the fabrication of the heat exchanger was completed. Author

N65-26069# Utah Univ., Salt Lake City. Dept. of Chemical Engineering
IGNITION AND COMBUSTION OF SOLID PROPELLANTS Technical Report, 1 Oct. 1963–30 Sep. 1964
John A. Keller, Alva D. Baer, and Norman W. Ryan (1964) 96 p refs
(Grant AF-AFOSR-40-64)
(SPC&CI-16; AFOSR-65-0936; AD-615103)

The results of the study of propellant ignition by high convective heat fluxes have shown that the gas velocity effect often observed in convective heating tests can be attributed to surface roughness. If this surface roughness is eliminated by the use of very smooth propellant surfaces or by the use of very high gas velocities which prevent ignition of projections on the surface, the relationship between ignition time and surface heat flux is simply the extrapolation of the low-flux ignition data. It appears that the effect of a burning rate catalyst is to increase the rate of reaction of propellant-component decomposition products at the propellant surface. Modification of the thermal ignition theory to include the effects of surface regression for high igniter heat fluxes has led to results which indicate that an ignition pressure effect on the overall ignition process can be observed with practical ignition systems even when the thermal response of the propellant itself is independent of pressure. Some quantitative results of the polymer decompositions study are presented. Preliminary results of a program to reevaluate the hot-wire ignition method for ignition studies are presented. N.E.A.

N65-26079*# Aeronutronic, Newport Beach, Calif.
ANALYSIS OF THE PROJECT FIRE RE-ENTRY PACKAGE FLOW FIELD Final Technical Report
W. C. Kuby, S. R. Byron, R. M. Foster, R. F. Hoglund, and M. Holt 8 Oct. 1964 203 p refs
(Contract NAS1-3419)
(NASA-CR-63388; U-3020) CFSTI: HC $6.00/MF $1.25 CSCL 20M

The objective of the Project Fire study reported herein is to predict theoretically the state of the gas in the flow field surrounding an Apollo type vehicle entering the earth's atmosphere at hypersonic velocity and to predict the related radiative and convective heating rates and their distribution over the body. In this study, two points on a nominal re-entry trajectory are considered. In the first case, the aerodynamic velocity is 34,582 fps and the altitude is 171,111 feet. Under these conditions, the chemistry is expected to be in equilibrium over the blunt body and the flow field is analyzed by Dorodnitsyn's method of integral relations as applied to the hypersonic blunt body problem. The flow over the back of the body is computed by the method of characteristics assuming attached flow. The second point on the trajectory is at an aerodynamic velocity of 37,439 fps and an altitude of 259,113 feet. The flow field in this case is not in equilibrium and the solution takes full account of the nonisentropic interaction between the chemical reactions and the flow field. The flow equations are again made manageable through the method of integral relations; chemical kinetic and vibrational non-equilibrium equations are integrated directly. Based on the flow field calculations the convective and radiative heat fluxes are determined. Author

N65-26092# Rensselaer Polytechnic Inst., Troy, N. Y.
SOME ASPECTS OF SURFACE TEMPERATURES OF SOLIDS WITH ROUGH SURFACES IN SLIDING CONTACT Technical Documentary Report, 1 Nov. 1963–31 May 1964
S. L. Pu and F. F. Ling Wright-Patterson AFB, Ohio, AF Mater Lab., Aug. 1964 106 p refs
(Contract AF 33(657)-10058)
(ML-TDR-64-202; AD-613167)

Steady-state solution of the heat equation is obtained for a truncated right circular cone with rotationally symmetrical heat input over the truncated surface and the remaining surfaces insulated. Average surface temperatures are computed for truncated cones of various opening angles. Assuming, in the first approximation, that truncated cones simulate surface asperities, then the solution may be used to give a measure of the correction factor for temperatures calculated using smooth surfaces, to give temperatures for rough surfaces. For the range of actual surface asperities, a simple approximate correction formula is found: $\bar{T} = T_0[1 + 0.5(\pi/2 - \theta_0)]$, where $\bar{T}$ is the average surface temperature over the heat input area, θ_0 is the semiopening angle measured in radians, and T_0 is $\bar{T}$ for $\theta_0 = \pi/2$. Also transient solutions of the heat equation are presented for stationary and moving bodies, respectively, with heat input considered as a simple discrete stochastic process in time and space. Numerical results show the maximum surface temperature flashes may be higher than the average surface temperature by a factor of 6. Author

N65-26100# Naval Ordnance Test Station, China Lake, Calif. Propulsion Development Dept.
THE EFFECT OF AN INTENSE MAGNETIC FIELD ON ROCKET NOZZLE HEAT TRANSFER. PART 1: THEORY AND SUPERCONDUCTING MAGNET EXPERIMENTS
Leroy J. Krzycki, William M. Byrne, Jr., and James B. Lee Nov. 1964 55 p refs
(NAVWEPS-8494, Pt. 1; NOTS-TP-3467; AD-613992)

A theoretical and experimental investigation of the effect of an axial magnetic field on rocket nozzle heat transfer, conducted by the Naval Ordnance Test Station, China Lake, California, is reported. Results of heat transfer experiments using an air-core superconducting solenoid were inconclusive. For magnetic flux densities up to 1.5 webers/m^2 there was no observable change in heat transfer from the combustion gas to the rocket nozzle wall. Rocket engine vibration decreased the stability of superconducting solenoid operation; in turn, the magnetic field perturbed the ignition characteristics and combustion chamber pressure of the rocket engine. The experimental investigation is continuing and will use a cryogenically-cooled magnet powered by a battery bank; results from this investigation will be documented in Part 2 of this NAVWEPS Report. Author

N65-26105# Aeronutronic, Newport Beach, Calif. Research Labs.
THERMODYNAMIC PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS Quarterly Letter Report No. 1, 1 May–15 Jul. 1964
D. L. Hildenbrand [1964] 9 p refs
(Contract AF 49(638)-1397; ARPA Order 317)
(QLR-64-10; AD-612361)

The heat of sublimination was measured for boron mounted on graphite, tantalum, and tungsten holders. A third-law analysis gave the following boron heats of sublimination: graphite holder (1950° to 2140° K), ΔK_{298} = 136.4 ±0.2 kcal/mole; tantalum holder (1950° to 2030° K), ΔH_{298} = 135.8 ±0.3 kcal/mole; and tungsten holder (1960° to 2060° K), ΔH_{298} = 136.0 ±0.2 kcal/mole. The second-law slope, considering all data, gave ΔH_{2030} = 134.7 ±3 and ΔH_{298} = 136.3 ±3 kcal/mole. These values are in good agreement with the 135.7 ±1.3 for boron derived from effusion measurements of the boron decomposition pressure over boron carbide. Also, the vapor pressures of strontium, barium, and cadmium chlorides were measured by the torsion–effusion method. Further, the mass spectrum of saturated cadmium chloride was studied in detail. The mass spectrum of BF_3(g) was also measured at several temperatures from room temperature to about 2000° K. E.E.B.

N65-26246# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
SENSITIVITY OF PROPELLANT SYSTEMS Quarterly Report, Jan. 1–Mar. 31, 1965

F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, J. Ribovich et al 21 May 1965 43 p
(BuWeps Order 19-65-8023-Weps)
(AD-464200)

The effects of scaling on the high-velocity–low-velocity and low-velocity–non-initiation thresholds were completed for nitroglycerin–ethylene glycol dinitrate–triacetin (NG–EGDN–TA) systems. As anticipated, there was a well-defined relationship between scale size and sensitivity. Also, acetone as a desensitizer of NG–EGDN was compared with triacetin and found to be somewhat more effective in suppressing the low-velocity detonation, although the high-velocity detonation threshold characteristics were essentially unchanged. A further examination was made of the role of occluded gas on the development of the cavitated region ahead of the low-velocity detonation reaction zone by comparing the behavior of vacuum degassed NG–EGDN with the material as-received. Although there were observed differences in the cavity sizes and the propagation rates, the response to a given stimulus was essentially the same. E.E.B.

N65-26253*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE VACUUM ULTRAVIOLET RADIATION FROM N^+- AND O^+-ELECTRON RECOMBINATION IN HIGH-TEMPERATURE AIR
Gerhard E. Hahne Washington, NASA, Jun. 1965 56 p refs
(NASA-TN-D-2794) CFSTI: HC $3.00/MF $0.50 CSCL 20M

A free electron may, while interacting with an N^+ or an O^+ ion, fall into the 2p shell to form a bound state of a neutral N or a neutral O atom, respectively, the transition being accompanied by the emission of a quantum of light. If the N^+ or O^+ ion is initially in a state of its ground configuration, for allowed transitions, this light will be of wavelength $\lambda \leq 1130$ Å for nitrogen, and $\lambda \leq 911$ Å for oxygen (i.e., in the region of vacuum ultraviolet wavelengths). The first step in estimating the contribution of such transitions to the rate of radiation of heated air was to calculate the cross sections for the inverse, photoionization processes, using the general formula of Burgess and Seaton. Given the composition of a sample of air, its absorption coefficient can be calculated from these photoionization cross sections, and if local thermodynamic equilibrium is assumed, the rate of radiation of air due to the corresponding recombination processes follows from Kirchhoff's law. This rate of radiation, integrated over the wavelength region from 400 Å to 1130 Å, has been calculated for air at several temperatures between 8,000° K and 24,000° K and several densities between 10^{-6} and 10^2 standard atmospheres for each temperature. In addition, data have been tabulated to facilitate calculation of the intensity (integrated over wavelength) of vacuum ultraviolet wavelength light at the surface of uniform (constant temperature and density) "thick" bodies of heated air. Author

N65-26256*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN ANALYSIS AND GENERAL CHARACTERISTICS OF FLAT-PLATE CENTRAL-FIN-TUBE SENSIBLE-HEAT SPACE RADIATORS
Arthur V. Saule, Richard P. Krebs, and Bruce M. Auer Washington, NASA, Jun. 1965 65 p refs
(NASA-TN-D-2839) CFSTI: HC $3.00/MF $0.75 CSCL 13A

An analysis is reported for the calculation of the characteristics, performance, weight, and area of a single-panel flat-plate central-fin-tube sensible-heat space radiator for a set of thermodynamic and fluid-mechanic conditions. The analysis takes into account the axial temperature gradient and the change in fin-tube effectiveness along the tube and fin. An example for each type of working fluid (liquid metal, liquid, and inert gas) is discussed in detail. The three examples were selected from representative applications to typical Rankine and Brayton cycle space power-generation systems as well as to secondary cooling loops. Examples show how changes in geometric parameters, mass flow rates, working fluids, and flow regimes (turbulent or laminar) affect the radiator weight and panel planform area. Particular examples indicate that there are unique ranges of geometric parameters (fin-tube profile ratio, initial conductance parameter, and tube inside diameter) for minimum weight radiators. The magnitudes of these parameters depend on the phase of the working fluid (gaseous or liquid), flow regimes, and other operating conditions. Author

N65-26257*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM DETAILS FOR DESIGN OF SENSIBLE-HEAT SPACE RADIATORS
Bruce M. Auer and Arthur V. Saule Washington, NASA, Jun. 1965 38 p refs
(NASA-TN-D-2840) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A program was designed for the calculation of the performance, weight, and area characteristics of a single-panel central-fin-tube flat-plate sensible-heat radiator for a set of thermodynamic and fluid mechanic conditions. The FORTRAN 7094 main program and its subroutines are reported herein. The program is based on the analysis, equations, and techniques developed and reported in NASA Technical Note D-2839. A typical computer printout sheet is included and a discussion of the definitions of the FORTRAN symbols and groups of numbers that designate the inputs, the error tests, and the outputs is presented. Author

N65-26269# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe
THE MECHANISM OF COMBUSTION OF AN AMMONIUM PERCHLORATE COMPOSITE PROPELLANT. PART II: DETERMINATION OF THE TEMPERATURE OF RADIATION OF HOT SURFACE PARTICLES [DER ABBRANDMECHANISMUS FESTER RAKETENTREIBSTOFFE AUF AMMONIUMPERCHLORAT-BASIS. TEIL II: MESSUNG DER STRAHLUNGSTEMPERATUR HEISSER OBERFLACHENELEMENTE]
H. Selzer 22 Jan. 1965 48 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-07) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 10 DM

During the process of combustion of a special kind of composite propellant consisting of ammonium perchlorate and polyisobutylene, bright particles were discovered in the burning surface. Using the described pyrometric device the temperature of these particles was determined to be (2000 ±150) ° K. By means of the described method and some photographic investigations these particles were interpreted to consist of carbon or very carbon-rich residues of the fuel polyisobutylene. Author

N65-26277# Library of Congress, Washington, D. C. Aerospace Technology Div.
THERMODYNAMIC FUNDAMENTALS OF RHEOLOGY [TERMODINAMICHESKIYE OSNOVY REOLOGII]
L. P. Koroshun 17 May 1965 11 p refs Transl. into ENGLISH from Prik. Mekh. (Kiev), v. 1, no. 1, 1965 p 92–97
(ATD-T-65-27; AD-463133)

A thermodynamic substantiation of rheological interrelationships in a medium is presented, with the assumption that only mechanical and thermal processes are taking place. It is also assumed that deformations are small and the density of the material remains unchanged. Problems investigated were plasticity, creep, and strain hardening of materials. It is established that strain hardening, accompanied by a separate process in the medium, is characterized by certain parameters which make it possible to explain the Bauschinger effect, the phenomenon of afteraction, relaxation of the material, the dependence of strain hardening on the rate of inelastic deformations, conversion of a part of the mechanical work into latent strain energy, and the initiation of anisotropy in the material. M.W.R.

N65-26297# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

FLOW STABILITY OF GAS–SOLIDS SUSPENSIONS Final Report

G. P. Wachtell and J. P. Waggener Feb. 1964 123 p refs

(Contract AT(30-1)-2974)

(NYO-2974-1) CFSTI: $4.00

One of the principal purposes of the work reported was to study the stability of gas-solids suspensions in the presence of a thermal gradient. A gas-solids centrifugal circulator, suitable for operation at a temperature of 600° F or greater and at 10 or more atmospheres of pressure, was designed and built. A study was conducted to investigate the suitability of a number of materials that may find application as the particulate matter of a gas-solids suspension from the standpoint of coolant activation and the concomitant need for radiation shielding of the cooling stream. A probe was developed which detects the accumulation and removal of graphite at a flow boundary surface. A basis for predicting the advent of suspension instability in the form of deposition at the cold wall of a heat exchanger was developed. This approach uses a simple model of shear stress at the wall and the force on the particle due to a thermal gradient at the wall. Preliminary observations of deposition and removal of graphite in carbon dioxide gas were obtained which encourage the use of the shear force–thermal force model as a basis for predicting the flow conditions necessary to maintain a stable gas-solids suspension. Other theoretical developments relate to the effect of turbulence in promoting removal of deposited graphite. Author

N65-26321# Rocketdyne, Canoga Park, Calif.

BASIC PHYSICAL PROCESSES OF SOLID PROPELLANT COMBUSTION: RESUME OF FIRST YEAR'S ACTIVITIES

L. W. Carlson 19 Mar. 1964 44 p

(Contract AF 49(638)-1208)

(HTUM-64-14; AD-461596)

Basic physical processes of solid propellant combustion were studied in an experimental and analytical program. Emphasis was placed on factors influencing unstable combustion; in particular propellant surface response to non-linear (shock) pressure disturbances, for aluminized and non-aluminized propellants. The past year's effort was limited to studying the effects that transient pressure disturbances have on the phenomena which occur at burning solid propellant surfaces, and developing techniques for making these studies; a model combustion chamber and shock tube assembly was used in the experimental portion of the program. Electronic Data Processing Machine (EDPM) programs were used to analyze the experimental data generated. The four experimental phases were divided into two study categories: in two of the phases grazing incidence waves were studied; two phases examined normal incidence waves. One of the grazing wave studies carried out in the model combustion chamber called the Pancake Motor; the other three were done in a shock tube, which is modified with internal apparatus for each individual experiment. Author

N65-26410*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

FLOW FIELD PREDICTION AND ANALYSIS, PROJECT FIRE Final Report

M. Vinokur, W. E. Nicolet, A. C. Buckingham, and H. Hoshizaki Mar. 1965 225 p refs

(Contract NAS1-3417; Proj. FIRE)

(NASA-CR-63401; M-12-65-1) CFSTI: HC $6.00/MF $1.25 CSCL 22C

This report presents the technical discussion of the methods used and the results of calculations on the details of the flow field, and convective and radiative heating predictions for the FIRE Reentry Package at two trajectory points. The calculations include determination of the complete inviscid flow fields, finite rate chemistry for the nonequilibrium flow, convective heating as well as both equilibrium and nonequilibrium radiative heating calculations. Results appear in graphical form with some additional flow-field data supplied in tabulated form. Descriptions of analytical techniques used, with supporting data and reference to governing principles, as well as related investigations are given. Added discussion on the computer codes used in the calculations and supplemental topics appear in the appendixes. Author

N65-26412*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF HOT-GAS SIDE HEAT-TRANSFER RATES FOR A HYDROGEN–OXYGEN ROCKET

Ralph L. Schacht, Richard J. Quentmeyer, and William L. Jones Washington, NASA, Jun. 1965 24 p refs

(NASA-TN-D-2832) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An experimental investigation was conducted at the Lewis Research Center to determine the hot-gas side heat-transfer rates in a rocket nozzle. Transient temperature measurements were made at five axial locations in a copper heat-sink nozzle having expansion and contraction area ratios of 4.64 with gaseous hydrogen and liquid oxygen as propellants. The nozzle was operated over a range of chamber pressures from 150 to 1000 pounds per square inch absolute at fuel percentages of 11 to 17, with most measurements made at approximately 15 percent hydrogen by weight. The data are presented in a correlation equation of the form $St^* Pr^{*0.7} = C Re_d^{*-0.2}$, where St^*, Pr^*, and Re_d^* are reference Stanton, Prandtl, and Reynolds numbers, respectively, and C is a constant. Over the Reynolds number range investigated, the results showed that no one constant C correlates the data for all axial locations; however the data did correlate well when each station was handled separately. The values of C varies from a high of 0.026 in the chamber to a low of 0.015 at the throat. This throat value is 42 percent lower than the widely used value of C = 0.026. Author

N65-26419*# Denver Research Inst., Colo.

SUBCOOLED BOILING IN A NEGLIGIBLE GRAVITY FIELD Final Report

Thomas R. Rehm 17 May 1965 146 p refs

(Grant NsG-143-61)

(NASA-CR-63419) CFSTI: HC $4.00/MF $1.00 CSCL 20M

Subcooled and saturated nucleate pool boiling was observed at camera framing rates from 6000 to 8000 pps in order that the dynamic forces acting on these bubbles at

normal gravity could be evaluated. Water at atmospheric pressure was used at heat fluxes of 50,000, 70,000 and 100,000 Btu/hr-ft^2 with subcoolings of 0, 10, 20 and 30° F for both normal and inverted heater orientations. Each bubble was analyzed frame by frame to determine, by graphical integration, its volume and center of mass position as a function of bubble lifetime. Graphical means were then used to evaluate the bubble forces associated with gravity, pressure, inertia, surface tension and viscous drag. By analysis of the bubbles it was determined that a wide range of bubble sizes exist at a given subcooling. In order to remove the size variation difficulty, reduced parameters for volume, center of mass, and time were used. With this adjustment it was found that bubbles of a given subcooling behaved in a similar manner as to their growth and force history for both normal and inverted boiling. The influence of gravity as a removal force was evaluated and it was found that for saturated bubbles the net removal force was very small and was due almost completely to gravity. This was not true for subcooled bubbles where the gravity force amounted to only 20 to 40 percent of the net removal force near separation. It is therefore concluded that in a negligible gravity environment subcooled, rather than saturated, boiling is the desired condition to use when nucleate boiling is being contemplated as a heat transfer mechanism.
Author

N65-26448# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
SIMPLE CRYOSTAT FOR COOLING SEMICONDUCTOR NUCLEAR RADIATION DETECTORS
W. Przyborski Dec. 1964 11 p refs
(Rept.-583/II/PL)

The design of a simple cryostat for nuclear radiation semiconductor detectors applications at low temperatures is described. In this cryostat, the sample's temperature of about 90° K can be achieved, using 1/4 l. of liquid nitrogen only, and 1l. suffices to maintain this temperature for 5–7 hours. The appropriate cooling time is 20 min., and 5–7 min. is required to warm up the previously cooled sample to the room temperature.
Author

N65-26549# Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
CALCULATED AERODYNAMIC HEATING EFFECTS ON A HEAT-SINK ICBM VEHICLE WITH A LOW WEIGHT-TO-DRAG RATIO
W. G. Burleson and M. W. Goodwin 15 May 1965 47 p refs
(ARPA Order 198; Proj. Defender)
(RS-TR-65-2; AD-464307)

This report contains calculated heat-sink skin thickness and weight requirements for a lightweight, low weight-to-drag ratio vehicle re-entering the Earth's atmosphere 35 degrees below the local horizontal at orbital velocities and surviving to an altitude near 45.72 kilometers. Calculated aerodynamic heating rates and structural temperatures for the vehicle skin, vehicle skin internal-structure joints, motor supports, and Ranger motor case are presented. Oxidation of TZM molybdenum alloy at elevated temperatures and high air mass velocities is discussed. The data in this report shows that, for survival to the vicinity of 45.72 kilometers, the required TZM molybdenum alloy and Inconel X skin of the considered vehicle weighs approximately 15.5 kilograms, with 12.56 kilograms of this contained in the TZM hemispherical tip. Internal metallic structures do not experience high temperatures until after these structures have performed their primary mechanical functions of vehicle integrity during all boost phases of flight. From a structure degradation standpoint, neither the external surface temperature rise of the expended Ranger motor case nor the inflight oxidation of the TZM molybdenum alloy hemisphere appears to be significant.
Author

N65-26574# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
ANALYSIS OF A TECHNIQUE OF MEASURING THE THERMAL DIFFUSIVITY OF POOR CONDUCTORS Technical Report, Jan. 1963–Jul. 1964
Robert William Ohlwiler Mar. 1965 58 p refs
(AFML-TR-64-374; AD-464664)

A method of measuring the thermal diffusivity of solids was experimentally investigated for the special case of poor conductors and compared with the theoretical relationship between the thermal diffusivity and the experimental parameters; heat loss and phase lag. The specific method of measuring the thermal diffusivity was by applying sinusoidal boundary conditions to the front face of a thin slab sample and monitoring the angular phase lag relationship of the back face of the sample, single crystal barium titanate. The thermal diffusivity of single crystal barium titanate was measured at room temperature, but the results are slightly dependent on an experimental heat loss factor which is uncertain to a degree. The thermal diffusivity was found to be

$$13.3 \times 10^{-3} \left\{ \begin{pmatrix} +2.4 \\ -1.8 \end{pmatrix} \times 10^{-3} \right\}$$

cm^2 sec^{-1}. The technique yielded a value for the specific heat as 0.101 ±.003 cal gm^{-1}° C^{-1} and gives the thermal conductivity of

$$31.2 \times 10^{-3} \left\{ \begin{pmatrix} +5.6 \\ -4.2 \end{pmatrix} \times 10^{-3} \right\} \text{ watt cm}^{-1}\text{° C}^{-1}$$

which is in agreement with literature values. The change in the experimental parameters, the phase lag and heat loss factor at elevated temperatures of 105° and 130° C was experimentally investigated. In addition to a description of the experimental techniques and an analysis of the results, there is a discussion of the thermal properties of barium titanate. A short review of the reported methods of measuring thermal diffusivity is also included.
Author

N65-26578# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
HEAT TRANSFER TECHNIQUES AND MEASUREMENTS IN THE DOUGLAS AEROPHYSICS LABORATORY HYPERVELOCITY IMPULSE TUNNEL
H. R. Miller Dec. 1964 49 p refs
(SM-43066)

This report presents the theory, fabrication, calibration, and data reduction procedures for thin-film resistance thermometer and calorimeter-type heat transfer rate gages used in the Douglas Aerophysics Laboratory Hypervelocity Impulse Tunnel (HIT). Included, also, is a section on experimental measurements and experience covering the following topics: development of a correlation parameter for stagnation point heat transfer measurements based on Fay-Riddell theory; estimation of the accuracy of experimental measurements; discussion of the effects of flow contamination on heating rates; and comments on heat transfer instrumentation used in the HIT.
Author

N65-26579# Florida Univ., Gainesville. Florida Engineering and Industrial Experiment Station
RECENT DEVELOPMENTS IN AIR-CONDITIONING TECHNIQUES. Bulletin Series No. 120
Jun. 1965 60 p Proc. of the 14th Ann. Air-Conditioning Conf., Feb. 25–26, 1965 *Its* Eng. Progress, Vol. 19, No. 6

The three main areas covered in this report are noise control, hospital air conditioning, and school air conditioning. Among the subjects discussed are: *New Media and Techniques for Control of Vibration and Structure-Borne Noise, Control of Airborne Spread of Bacteria in Hospitals, Electric Space Heat for Industry,* and *Ventilating Ceiling Technology.* M.W.R.

N65-26597*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FREE-FLIGHT MEASUREMENTS OF STAGNATION-POINT CONVECTIVE HEAT TRANSFER AT VELOCITIES TO 41,000 FT/SEC
Dale L. Compton and David M. Cooper Jun. 1965 28 p refs
(NASA-TN-D-2871) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Measurements of stagnation-point convective heat-transfer rates in air, at velocities to 41,000 ft/sec, are presented. A new technique was developed at the Ames Research Center to make these measurements. In this technique, 1/4-inch-diameter aluminum hemispheres are gun launched into the prototype of the Ames hypervelocity free-flight facility at a velocity of 24,000 ft/sec into still air, and at combined velocities of 36,000 and 41,000 ft/sec into the countercurrent airstream. At some point on its flight path the model begins to melt, and molten aluminum streams from the model surface into the wake, where it can be seen in spark shadowgraphs. The stagnation-point heating rate is then deduced by computing the heating rate required to produce melting at the observed time. The low-speed tests at 24,000 ft/sec served as calibration tests for the technique and showed its workability. To study the possible effects of model material on the convective heating rate, several of the aluminum models were plated with a 0.0005-inch-thick nickel shell. These models were also subjected to calibration tests and then used for measuring convective heating rate at a velocity of 36,000 ft/sec. The heating rates measured from all of the tests agree reasonably well with each other and with the majority of shock-tube data, and support theories which predict that ionization effects on convective heating rates in air will be small. No differences in heating rate were found for the two model surface materials tested. Author

N65-26620# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOME SPECIAL FEATURES OF THE COMBUSTION OF LIQUID-FUEL DROPLETS [NEKOTORYYE OSOBENNOSTI GORENIYA KAPLI ZHIDKOGO TOPLIVA] Translations of Soviet-Bloc Scientific and Technical Literature
V. A. Fedoseyev and D. I. Polishchuk 28 May 1965 10 p refs Transl. into ENGLISH from Tr. Odesskogo Gosuniv., Ser. Fiz. Nauk, v. 152, no. 8, 1962
(ATD-T-65-34; AD-464575)

Aerosols containing liquid fuel droplets were studied by a tracing method for their evaporation and burning rate at combustion, that combined photographic recordings of evaporating or burning droplets in motion and kinetic data from measurements of the total evaporation or burning time of particles of various sizes to plot droplet mass versus time graphically. Increased temperatures led to a decrease in droplet lifetime and occupied aerosol area and thus established the dependence of the droplet lifetime on the stream velocity at varying temperatures. Experiments with single, small particle-droplets of plexiglass and also with burning aerosols of these particles showed that the length of the continuous flame depends on the droplet size and that differences in droplet size are indicated mainly by the different distances at which combustion is completed. G.G.

N65-26639*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CHARTS FOR APPROXIMATE THERMODYNAMIC PROPERTIES OF NITROGEN–OXYGEN MIXTURES
Bruce Fowler and Ronald D. Brown Washington, NASA, 1965 116 p refs
(NASA-SP-3017) CFSTI: HC $1.25/MF $0.75 CSCL 07D

Charts have been prepared which show the equilibrium thermodynamic properties of four nitrogen-oxygen mixtures, one of which approximates air (80 percent N_2 and 20 percent O_2, by volume). The temperature range was from 200° to 15,000° K and the pressure range, from 10^{-4} to 10^2 atmospheres. The thermodynamic properties have been computed in closed form, starting from the approximate partition functions. Author

N65-26646*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL VERIFICATION OF AN ANALYTICAL DETERMINATION OF OVERALL THERMAL CONDUCTIVITY OF HONEYCOMB-CORE PANELS
C. W. Stroud Washington, NASA, Jun. 1965 15 p refs
(NASA-TN-D-2866) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The overall thermal conductivity of four honeycomb-core panels was determined over a temperature range from 1200° R (670° K) to 1900° R (1050° K). The brazed panels were fabricated from a cobalt-base alloy. The ratio of height to cell width of the honeycomb core in the panels varied from 1 to 5. Thermal conductivities were determined in an insulated apparatus which utilized a steady-state heat flow through the panels. In order to verify an analytical determination of the overall thermal conductivity of honeycomb-core panels, the results of the present investigation were compared with the results calculated from an analysis reported in NASA TN D-714. There was a root-mean-square deviation of 7 percent between analytical and experimental results. Author

N65-26654*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF MULTIPLE-CHAMBER ARC HEATER WITH FOUR MAGNETICALLY SPUN DIRECT-CURRENT ARCS
Donald R. Boldman, James P. Campbell, and Paul C. Simon Washington, NASA, Jun. 1965 19 p refs
(NASA-TN-D-2891) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The arc heater was tested over a range of power levels and nitrogen flow rates to determine its value as a heater for hypersonic wind tunnels. Enthalpy levels ranged from 4000 to 6000 Btu per lb at a nominal pressure of 2.0 atm and a nozzle throat diameter of 3/4 inch. The efficiency of the arc chamber ranged from about 45% at a power level of 800 kW to about 30% at 1200 kW. At 1000 kW the electrode heat loss was 47% of the arc power for the highest N_2 flow rate of 0.058 lb per sec. The corresponding plenum and nozzle losses were 18% and 3% of the arc power. An attempt was also made to correlate measured values of stagnation enthalpy with the values predicted on the basis of equilibrium sonic flow. The results indicated that the measured stagnation enthalpy was generally higher than that predicted for one-dimensional real-gas sonic flow. The reason for this is unclear; however, the same general trend was noted in previous investigations of single-arc heater performance. E.E.B.

N65-26656*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMODYNAMIC PROPERTIES OF CESIUM UP TO 1500°K
Sheldon Heimel Washington, NASA, Jul. 1965 31 p refs
(NASA-TN-D-2906) CFSTI: HC $2.00/MF $0.50 CSCL 07D

Tables of thermodynamic properties of elemental Cs are compiled for both the pure species and the equilibrium vapor on the saturation line using selected values of 10500 cal/mole for the heat of dissociation of the dimer and −18920 cal/mole for the heat of condensation of the monomer. The equilibrium vapor properties of the condensed Cs are given to 1500° K, and the properties of gaseous monomer and dimer are given to 2500° K. The following thermodynamic functions of mixture properties on the saturation line are given: temperature, total vapor pressure, weight fraction of dimer in vapor phase, molecular weight, specific volume, density, enthalpy of condensed phase, enthalpy of vaporization, enthalpy of vapor phase, entropy of condensed phase, entropy of vaporization, entropy of vapor phase, and the heat capacities. Assigned enthalpies are relative to enthalpy of the crystal at 298.15° K, which is taken as zero. E.E.B.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-25875# Congress. House. Committee on Government Operations.
GOVERNMENT OPERATIONS IN SPACE (ANALYSIS OF CIVIL–MILITARY ROLES AND RELATIONSHIPS) Thirteenth Report
Washington, GPO, 1965 142 p Based on a study by the Military Operations Subcommittee, 89th Congr., 1st Session, H.R. 445, Union Calendar No. 204

This report to the committee on Government Operations, based on a study by the Military Operations Subcommittee, is concerned with government operations in space and considers the civil–military roles and relationships in this complex area. E.E.B.

N65-25995# Army Missile Command, Huntsville, Ala. Research and Planning Section
SCAMP: SYSTEMS CHARACTERISTICS AFFECTING MISSILE PRODUCTION
25 Nov. 1963 49 p
(AD-613201)

A method for the determination of cost and man-hours required to load a solid propellant type motor for a new missile where the system characteristics are known is discussed. It was assumed that a direct relationship exists between the cost of loading a solid propellant missile motor and the physical and performance characteristics (technical requirements) of the motor. The four characteristics chosen for the study were volume of the motor, propellant weight, motor weight, and total impulse. Seven missiles were chosen for the motor loading. These missiles were chosen because all were solid-propellant motors, weights varied from 400 lbs to 7000 lbs, known characteristics were available, and cost and man-hour data had been previously determined. It was concluded that there is a definite relationship between cost and characteristics and between man-hours and characteristics of the motors used in the study. E.E.B.

N65-26201 Joint Publications Research Service, Washington, D. C.
THE FIRST ALL-UNION CONFERENCE ON TECHNICAL CYBERNETICS
I. Ushakov *In its* Tech. Cybernetics, No. 1, 1965 8 Jun. 1965 p 298–300 (See N65-26175 15-10) CFSTI: $7.00

During the First All-Union Conference on Technical Cybernetics, day sessions made up of six sections were heard in which 100 reports were given. In the session of the first section reports were presented on devices for selection and transmission of information. Reports on optimal procedures for production control were given in the second section. The third section dealt with control of production processes. The majority of the reports of the fourth section discussed investigation of the production processes. The practical problems related to construction and operation of the different types of energy systems were investigated in the session of the fifth section—energetics and transportation. In the work of the sixth section, reports on systems technology were presented. N.E.A.

N65-26272# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
W. D. Garrett et al Mar. 1965 56 p refs CFSTI: $1.25

CONTENTS:

1. COLLECTION OF SLICK-FORMING MATERIALS FROM THE SEA SURFACE W. D. Garrett p 1–5 refs
2. NRL PROGRESS IN RADIO ASTRONOMY (1963-1964) E. F. McClain p 6–9 refs
3. APPLICATIONS RESEARCH p 10
4. ATMOSPHERE AND ASTROPHYSICS p 10
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11. RADIO p 45
12. PUBLISHED REPORTS p 50–53

N65-26415*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management
THE ULTILIZATION OF INFORMATION SOURCES DURING R&D PROPOSAL PREPARATION
Thomas J. Allen Oct. 1964 34 p refs Sponsored by NASA (Grant NSF GN-233)
(NASA-CR-63407) CFSTI: HC $2.00/MF $0.50 CSCL 05B

Twenty-two proposal competitions for government R&D contract, involving 156 proposal teams, are examined to determine the relative use of three sources of technical information. The extent to which each proposal team relied upon literature search, the use of staff specialists within the lab and the use of outside sources of information is related to the rated technical quality of its proposal, and to other variables characterizing the proposal team and its parent laboratory. Twenty-two percent of the total time expended by 156 proposal teams was devoted to the seeking and gathering of technical information. Of the three information sources used, only one, laboratory specialists, appears to be at all directly related to the technical quality of the product and this relation

is weak and unreliable. Technical quality is inversely related to the extent to which the proposal team relies upon individuals outside of the laboratory as sources of information. Author

N65-26416*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-32, VOLUME IV, FOR THE PERIOD 1 FEBRUARY–31 MARCH 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Apr. 1965 317 p refs
(Contract NAS7-100)
(NASA-CR-63396) CFSTI: HC $7.00/MF $1.75 CSCL 22A

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1. SYSTEMS ANALYSIS p 1–11 refs
2. COMPUTER APPLICATIONS p 12–24 refs
3. ENVIRONMENTAL REQUIREMENTS p 25–44 refs
4. SPACE SECONDARY POWER p 45–51
5. GUIDANCE AND CONTROL ANALYSIS AND INTEGRATION p 52–57 refs
6. GUIDANCE AND CONTROL RESEARCH p 58–67 refs
7. MATERIALS p 69–72 refs
8. LUNAR SPACECRAFT DEVELOPMENT p 72–74
9. APPLIED MECHANICS p 75–84 refs
10. INSTRUMENTATION p 85–89
11. AERODYNAMIC FACILITIES p 89–107 refs
12. SOLID PROPELLANT ENGINEERING p 109–115 refs
13. POLYMER RESEARCH p 115–126 refs
14. RESEARCH AND ADVANCED CONCEPTS p 127–151 refs
15. LIQUID PROPULSION p 151–166 refs
16. LUNAR AND PLANETARY INSTRUMENTS p 167–173
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19. CHEMISTRY p 196–221 refs
20. FLUID PHYSICS p 222–229 refs
21. PHYSICS p 230–236 refs
22. APPLIED SCIENCE p 237–241 refs
23. COMMUNICATIONS ELEMENTS RESEARCH p 243–253 refs
24. COMMUNICATIONS SYSTEMS RESEARCH: INFORMATION PROCESSING p 254–272
25. COMMUNICATIONS SYSTEMS RESEARCH: PLANETARY RADAR p 273–276
26. COMMUNICATIONS SYSTEMS RESEARCH: COMMUNICATION AND TRACKING p 277–308 refs

N65-26424*# Massachusetts Inst. of Tech., Cambridge. School of Industrial Management
THE DESIGN OF RESEARCH AND DEVELOPMENT POLICY
Edward B. Roberts 16 Jan. 1963 42 p refs
(Grant NsG-235-62)
(NASA-CR-63406) CFSTI: HC $2.00/MF $0.50 CSCL 05A

Problems of research and development managers demand a management laboratory for the design and testing of new policies. This laboratory approach is now possible based on the concepts and methodology of Industrial Dynamics and on a new systems framework for representing project life cycles. The bases for a behavioral model of R and D projects are presented, as are some results of the computer simulation studies of the model. Conclusions drawn from these investigations suggest the important of risk-taking and integrity of R and D organizations, and also indicate several areas in which government procurement policies seem self-defeating. Author

N65-26425*# Massachusetts Inst. of Tech., Cambridge. School of Industrial Management
ENGINEER DYNAMICS AND PRODUCTIVITY IN R AND D PROJECTS Organizational Research Program
Edward B. Roberts Oct. 1963 27 p refs
(Grant NsG-235-62)
(NASA-CR-63405) CFSTI: HC $2.00/MF $0.50 CSCL 05I

The dynamic process of engineer acquisition and utilization in R and D projects is diagrammed and described. Policies for engineer acquisition, training, and transfer are discussed. The bases for engineer productivity are defined and organized into a structural representation that includes effects of technology, experience, management, and organizational factors. Some results of computer simulations of an R and D project model are presented, indicating the sensitivity of project outcomes to various training times, initial staff sizes and other factors affecting productivity. Author

N65-26429# Office of Aerospace Research, Washington, D. C.
ANNUAL REPORT, 1964
[1965] 54 p
(OAR-64-15; AD-609295)

Research accomplishments for the Office of Aerospace Research are discussed and include crystals that give off colors, better solar cells, a nuclear spectroscopy technique based on observation of isobaric analog resonances in medium weight nuclei, fast chemical reactions, artificial metals, computer designed electrical networks, reliability calculations, computer pattern recognition, crossed-field charged particle delay lines, a new method of studying plasmas, soft X-rays for material studies, composite materials, oxygen passivation, a mechanical accelerator for hypersonic flows, aerodynamic control for high altitude vehicles, laser light source for wind tunnels, increased use of thin-walled structures, new means of energy conversion, particle separator, geodetic satellites, high altitude temperature, cosmic radiation, a new stellar interferometer, the mechanism of memory, the eye image coding technique, and physical environment effect on human performance. R.N.A.

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